SMITHSONIAN INSTITUTION

UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME 57

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The present volume is the fifty-seventh of this series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

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WILLIAM DEC. RAVENEL,
Administrative Assistant to the Secretary,
in charge of the United States [illegible] Museum.

MARCH 20, 1921.

TABLE OF CONTENTS.

[1] Date of publication.

[1] Date of publication.

TABLE OF CONTENTS.

[1] Date of publication.

[1] Date of publication.

LIST OF ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

ON SOME HITHERTO UNRECOGNIZED REPTILIAN CHARACTERS IN THE SKULL OF THE INSECTIVORA AND OTHER MAMMALS.

By Jacob L. Wortman.
Of Brownsville, Texas.

While studying the relations of the lachrymal bone in the splendid collections of recent mammalian osteology in the United States National Museum, my attention was first attracted to the occurrence of certain supernumerary osseous elements in the skulls of various species of the Macroscelididae or Jumping Shrews of South Africa. This subject proved of such absorbing interest that I was led to extend my researches, so as to take in practically all the orders of living mammals. It is the object of the present paper, therefore, to present the results of these studies, together with such general conclusions bearing upon the broad problem of mammalian descent, as seem to be reasonably warranted by the facts herein revealed.

Since I have been unable to find any reference to these supernumerary elements in the skulls of mammals in any of the standard works treating of mammalian osteology, or in any special papers upon particular groups of the Mammalia, I take it that the subject is practically a new one and has not received the attention its importance so amply demands, if we wish to get a clear and comprehensive understanding of some of the fundamental relations of the Mammalia to their reptilian or quasi-reptilian ancestors.

Skull of Rhynchocyon.—I shall begin with the description of certain interesting features of the skull of the Insectivora, after which I shall consider these same characteristics in other groups. By far the most important, from this point of view, is the single skull of *Rhynchocyon petersi*, No. 182561, of the Museum collection, being that of a young adult female in perfect condition and just of the proper age to show all the sutures clearly, except those entering into the tympanic bulla, which would require a somewhat younger individual. As will be gathered from the description, this skull exhibits some astonishing characters for a mammal, and it is easily one of the most interesting and important specimens which it has ever been my good

fortune to examine. On this account I have found it desirable to describe it in considerable detail.

In comparison with other members of the Insectivora, the skull (figs. 1 and 2) is remarkably broad and flat when viewed from above, approaching in this respect many of the Rodentia, and exceeding that of *Galeopterus* or *Myrmecobius*. When seen from the side its vertical depth in front of the orbits is much reduced, and the whole area of the top of the skull is wedge-shaped, with a more or less pointed extremity in front. The nasals are relatively short, being less than one-third the length of the skull, and at their anterior free extremities are thickened, and flared upwards; a little behind the center they are widened somewhat, and still behind this they terminate in sharp

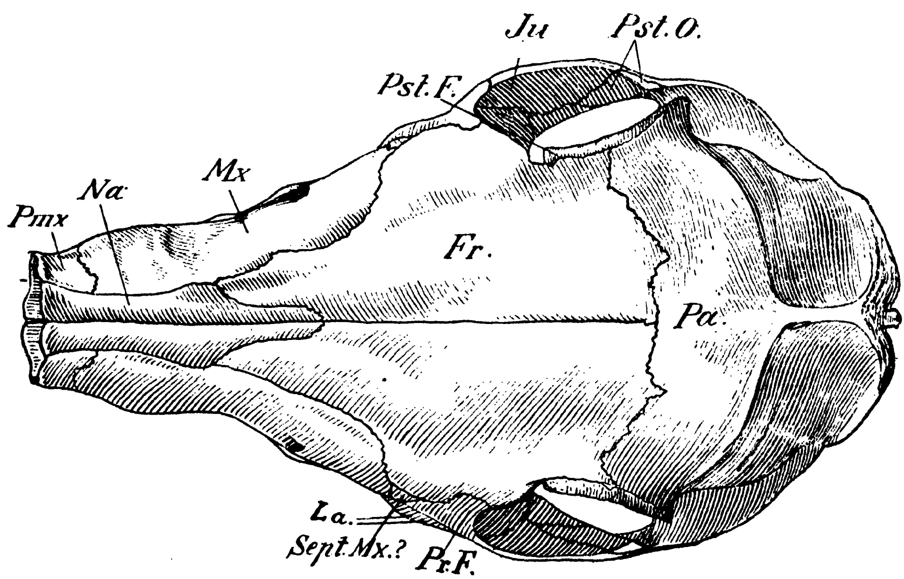

FIG. 1.—RYNCHOCYON PETERSI. No. 182561, U.S.N.M. *Fr.*, FRONTAL; *Ju.*, JUGAL; *La.*, LACHRYMAL; *Mx.*, MAXILLARY; *Na.*, NASAL; *Pa.*, PARIETAL; *Pmx.*, PREMAXILLARY; *Pr. F.*, PREFRONTAL; *Pst. F.*, POST-FRONTAL; *Pst. O.*, POSTORBITAL; *Sept. Mx.* ? SEPTOMAXILLARY. × 2.

points where they articulate with the frontals. The premaxillaries are short and do not send processes backward alongside the nasals but a short distance. Like the nasals, where they form the boundary of the anterior narial opening, they are everted or flared outward and at the point of junction with the nasals are somewhat thickened. This thickened border undoubtedly serves for the attachment of the unusually long cartilaginous snout, which is so common a feature of the Insectivora. The maxillaries form nearly the whole of the side of the face, which is separated from the top of the skull by a rather sharp angulated border. The infraorbital opening is large and issues just above the anterior border of the first molar. Behind this the face is deeply concave from above downwards, the concavity extending

backwards underneath the prominent and flaring edge of the orbital cavity. At the posterior end of the maxillary, commencing above the anterior border of the second molar, is the unusually prominent masseteric ridge, which extends backwards on the underside of the jugal arch as far as the back of the orbit. The frontals entering into the formation of the top of the skull are unusually broad; they reach their greatest breadth where they join the lachrymals near the anterior border of the orbit, and terminate in front in pointed extremities which are received between the nasals and premaxillaries. Behind they articulate with the parietals by a gently curved suture, whose

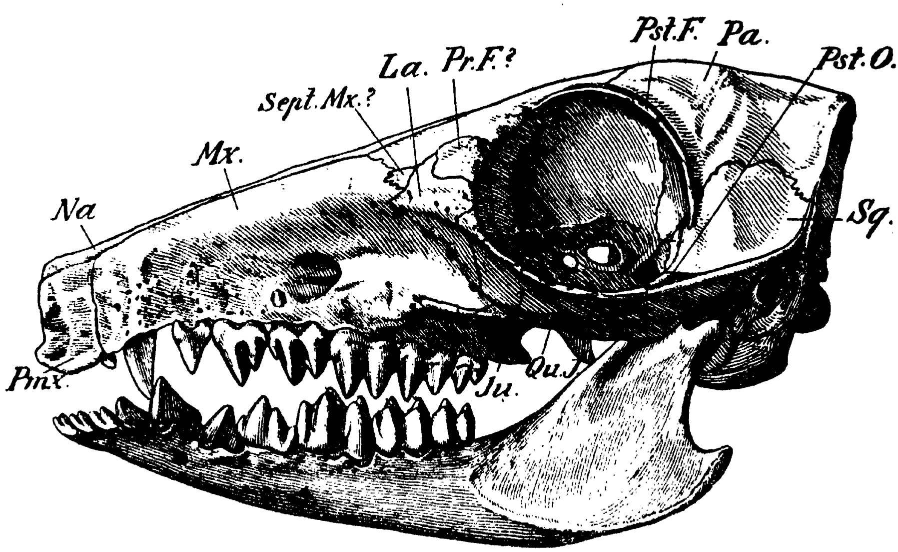

FIG. 2. RYNCHOCYON PETERSI. *Qu. J.*, QUADRATOJUGAL; *Sq.*, SQUAMOSAL. × 2. (OTHER LETTERS AS IN FIG. 1.)

concavity is directed forwards, and upon the upper border of the eye cavity they are deeply notched.

The parietals, like the frontals, have an unusual breadth and are rather short from before backwards; they articulate in front with the frontals and behind with the occipital, quite in the usual way in the mammalian skull. There is a short inconspicuous sagittal crest, from the anterior end of which diverge two faint ridges passing almost directly outwards to the tips of the postorbital processes. These ridges, together with the occipital crest behind, are of importance as marking the area of attachment of the temporal muscle, and serve to delimit rather sharply the *temporal area*, of which more will be said later. The outstanding feature of the parietals is that they are produced upon either side into strong depending processes, which furnish the upper posterior boundary of the orbital cavity. The presence of a postorbital process is not unusual in the skull of the mammal, but

in all other forms in which it is present, as far as I am aware, it is furnished by the frontal and not the parietal. It may arise at the junction of these two bones on the edge of the orbit, and the parietal may contribute a share in its formation, but *Rhynchocyon* is the only form that I know in which the postorbital is furnished exclusively by the parietal. In conjunction with this unique formation of the postorbital process there is another still more remarkable structure to be noted just at this point. On the rim of the orbit, reaching from the supraorbital notch of the frontal, and extending well down toward the tip of the postorbital process, is a long slender bone separated by distinct sutures on either side of the skull from both the parietal and frontal. This extra bone therefore forms the free projecting edge of the orbital rim and overlaps the junction between the frontal and parietal where they meet above the eye. In the specimen before us these bones are symmetrically developed upon the two sides of the skull.

The occipital surface is well separated from the sides and top of the skull by a well-defined though not unusually prominent occipital crest. The foramen magnum is relatively large and the condyles well separated. There is no trace of a paroccipital process. From the center of the occipital crest a sharp spinous ridge descends toward the foramen magnum, corresponding to the nuchal spine and serving for the attachment of the nuchal ligament. There is a considerable exposure of the mastoid portion of the periotic on the postero-lateral aspect of the occipital region, which extends as high up nearly as the top of the squamo-parietal suture.

Of the orbital cavity and the formation of the zygomatic or quadrato-jugal arch, there are some points of unusual interest and importance to note. The squamosal is of fairly good size, and extends well up on the side of the brain case, overlapping the edges of the parietal in the usual manner. The posterior root of the zygoma forms a wide concave projection behind the eye cavity, and passes backwards to become continuous with the descending branch of the occipital crest. In front it is produced into a relatively stout process, which articulates directly in advance of it with the bone which runs forward to the maxillary. It does not override this latter bone in its articulation, but abuts against it, being received into a more or less V-shaped pocket.

One of the most remarkable features in the composition of the jugal arch is the presence of a separate and distinct bone, lying near the anterior end of the zygomatic process of the squamosal, at its junction with the element in advance of it already mentioned. It is of an elongated splintlike form, extending forwards toward the maxillary and resting upon the two elements below it, presently to be described. It terminates behind in a more or less trihedral swelling or process,

which rests upon the anterior end of the zygomatic process of the squamosal and forms the postorbital process of the jugal arch, for the attachment of the postorbital ligament, which connects the tip of the postorbital process of the parietal with the zygoma, thus completing the posterior boundary of the eye cavity.

Immediately in advance of the bone just mentioned is a broad, thin concave bone which forms the principal part of the floor of the orbit upon the outer side. It is thin and extended outwards in such a manner as to give a characteristic flare to the lower and anterior portion of the floor of the eye cavity. In front it touches the maxillary and is continued forwards to articulate with the lachrymal, thus forming the anterior lower free rim of the orbit.

No less astounding in the formation of the jugal arch of this remarkable skull is still another element, which occupies a position upon its under surface. It articulates in front with the maxillary, sending a long pointed process forwards upon the outer side of this latter bone at the masseteric ridge, and extending backwards on the underside of the zygoma, beneath the zygomatic process of the squamosal. In its backward extension it reaches the glenoid cavity, and takes almost as great a share in its formation as in the Marsupials. Upon its under surface it is produced into a well-defined sharp ridge, which is a direct continuation of the prominent masseteric ridge or process of the maxillary. Above it is in contact with the so-called malar or jugal, and the small bone which forms the postorbital process of the jugal arch already described.

The anterior boundary of the orbit is formed principally by the large lachrymal, which spreads out upon the face, and articulates below with the malar, upon the orbital rim. Above, it articulates with the frontal, and in front with the maxillary. Within the orbital cavity it has the usual relations found in the Macroscelididae, and is perforated by a large lachrymal foramen situated entirely within the orbit. Lying at the angle of junction between the maxillary, frontal, and lachrymal, upon the side of the face, at some distance from the edge of the orbit, is another small bone which is not common in the mammalian skull. It is of a triangular form, with a relatively long pointed extremity, extending backwards between the frontal and lachrymal, and is equally and symmetrically developed upon the two sides of the skull.

Near the middle of the lachrymal, on the anterior edge of the orbit, is seen the remains of a suture, which runs forwards more than half the length of the bone and then ceases in such a way as not to divide the lachrymal completely, nor to complete the boundary of another element. No distinct traces of this suture can be made out, however, on the inside of the eye cavity, and if the lachrymal was really divided

into an additional segment it will require a younger stage of the skull to establish the fact beyond question.

As it is not the object of the present study to go into the question of the relationship of *Rhynchocyon* and its allies, I shall omit a description of the base of the skull, teeth, etc. The lower jaw, however, displays several features which come within the scope of the present study, and I here call attention to them. The back part of the jaw has a very characteristic and peculiar appearance, which is not at all usual in the Mammalia. This is seen in the eversion or outward twist of its angular portion, the long backward slope of the ascending portion of the ramus, the very small coronoid, and the unusually high position of the condyle. The condyle has its greatest development in a transverse direction and is convex from before backwards. That which is of the greatest interest, however, is what appears to be an indistinct suture, separating the articular surface or head of the condyle from the rest of the bone, as if it were an epiphysis. This suture, if it is really the remains of one, follows the limits of the articular surface closely in front, but is not so evident behind. In a like manner, upon the inner surface of the jaw situated just below the opening of the inferior dental canal is a small sunken tubercle or bony knob, well marked off by a distinct fissure, resembling the remains of a suture and connected behind by a distinct groove, which extends backwards to the edge of the jaw just below the angle. This groove when examined carefully has the appearance of being the remains of a suture, but this may be deceptive. It may be said of both of these peculiarities of the jaw that they are symmetrical or exactly alike in the opposite halves.

Cercoctenus and other Macroscelididae.—The first of these genera is represented by some 32 skulls of all ages, of the species *Cercoctenus sultana.* In this species the lachrymal has a small though distinct preorbital extension with the opening of the lachrymal canal within the orbital cavity. On the rim of the orbit it is produced into an unusually prominent *crista orbitalis,* which is greatly augmented by the addition of two flattened plate-like ossicles, articulating by their applied edges, with its superior and outer border. The upper of these ossicles, which is the smaller of the two, lies at the junction of the lachrymal with the frontal, and the lower or larger, articulates with the lachrymal and malar near the point where these two bones join.

The lachrymal has the usual form and relations in this group of Insectivores, articulating above with the frontal, in front with the maxillary, on the rim of the orbit with the malar, and within the eye cavity with the palatine, maxillary, and frontal. The presence of these ossicles here described, together with the prominent *crista* to which they are attached loosely by suture, give a characteristic

winglike appearance to the anterior part or edge of the orbital cavity not seen elsewhere among mammals.

Of the 30 or more skulls of this species in the collection, all of them without exception show the presence of these bones, where they have not been scraped away or detached in the course of preparation. Even in those skulls in which they have been lost, the thickened and roughened edge of the *crista*, however, gives ample evidence of their having been present in the fresh state, and I conclude, therefore, that their occurrence is a constant and well-marked feature of this species. Of the 20 specimens out of 32 in which these ossicles are preserved there appears to be little variation, either in the size or position which they occupy on the edge of the orbit.

At least one of these ossicles is found in the same position on the border of the lachrymal, as just described in *Cercoctenus sultana*, in one of the three skulls of *Petrodromus tetradactylus* in the collections; but there can be little doubt from appearances that it was originally present in all three cases, but has been subsequently lost in preparation. I am unable to say just what degree of constancy it has in the skull of this species, but it is not altogether unlikely that it is very generally present. In a like manner in a single skull of *Macroscelides*, there is one of these ossicles present upon one side with evidence that it has been lost from the other. In the remaining genera, *Nasilio* and *Elephantulus*, these ossicles are occasionally present, but it is always as a very thin and weak spicule of bone. Just to what extent its absence may be due to faulty preparation I am unable to say, but I am of the opinion that careful investigation will show its frequent presence.

None of the preceding genera exhibits any of the remarkable characters of the jugal arch of *Rhynchocyon*, above described. The skull is high and narrow in front of the orbits, the nasals are long and narrow, and the premaxillae send long-pointed processes backwards between the nasals and maxillaries. There is no postorbital process of either frontal or parietal above, and but a very faint indication of a postorbital process of the jugal arch, which is weak and slender. In the lower jaw the ascending portion of the ramus rises more abruptly, but the condyle is placed high above the tooth row, and the coronoid is small as in *Rhynchocyon*.

Skull of Tupaia.—In the species of this genus the skull has a very considerable interorbital width, as in *Rhynchocyon;* the snout is long and pointed, but the brain case is much more capacious, and as a consequence the upper part of the cranium is more rounded. The postorbital process above (fig. 3), while not as primitive as that of *Rhynchocyon*, is, however, in a stage of development not far removed from it; it apparently arises from the frontal, as a long slender strip of bone, is directed backwards and outwards, being closely applied

to the parietal for a considerable distance, and passes down behind the eye cavity to join the ascending process of the postorbital process of the jugal arch, with which it becomes continuous, and in old individuals firmly united by suture. The orbital cavity is thus completely encircled by bone, by the completion of its posterior boundary.

In studying a number of young skulls of the various species of *Tupaia* and allied genera the postorbital process of the frontal is found to be always separated from the frontal for a considerable distance forwards, almost as far, in fact, as the supraorbital notch, which in this group is converted into a foramen; and while I have never seen it completely separated from the frontal, there is every reason to believe, and I am fully convinced that younger specimens will show, that it exists as a separate bone, ossifying from a separate and distinct center. If this is true, then it follows that it is strictly homologous with, and corresponds to, the element in this position

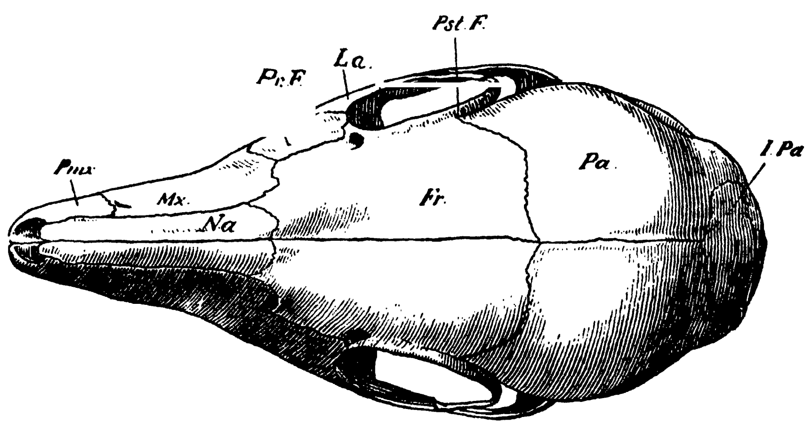

FIG. 3.—TUPAIA. *Fr.*, FRONTAL; *I. Pa.*, INTERPARIETAL; *La.*, LACHRYMAL; *Mx.*, MAXILLARY; *Na.*, NASAL; *Pa.*, PARIETAL; *Pmx.*, PREMAXILLARY; *Pr. F.*, PREFRONTAL; *Pst. F.*, POSTFRONTAL. × 2.

in the skull of *Rhynchocyon*, just described. The temporal area is somewhat larger than in *Rhynchocyon* and is sharply delimited by the diverging branches of the sagittal crest, which is very little developed even in aged individuals. The share which the squamosal takes in the formation of the outer wall of the brain case is small, and the considerable exposure of the mastoid portion of the periotic upon the postero-lateral aspect of the skull, rises well above the squamo-parietal suture. There is no paroccipital process.

The jugal arch of *Tupaia* offers some points of unusual interest. The most striking feature, at first glance, is the presence of a large foramen, fenestra, or vacuity, piercing the arch below and slightly in advance of the postorbital process of the zygoma, as it rises up to meet the corresponding process from above. Among the Insectivora this vacuity is peculiar to *Tupaia* and the closely related genera, in which it is usually very large and roomy, but is reduced to a small

foramenlike aperture or may be entirely wanting in *Ptilocercus*. It is usually well developed in all the Primates, where it varies in size from a large fenestra to a small foramen, or complete absence.

That which is of the greatest interest in connection with this vacuity in *Tupaia* is the occasional presence of a well-defined suture, in young skulls, dividing the narrow rodlike upper boundary near its middle and a suture separating its posterior boundary, just in advance of the suture between the squamosal and jugal. This, it will be seen (fig. 4), cuts off a separate more or less T-shaped bone, with the short stem forming the upper back part of the boundary of the fenestra and two prongs curved slightly upwards, one rising up to meet the postorbital process from above and the other passing forwards on the upper border of the fenestra towards the lachrymal. Again in many young

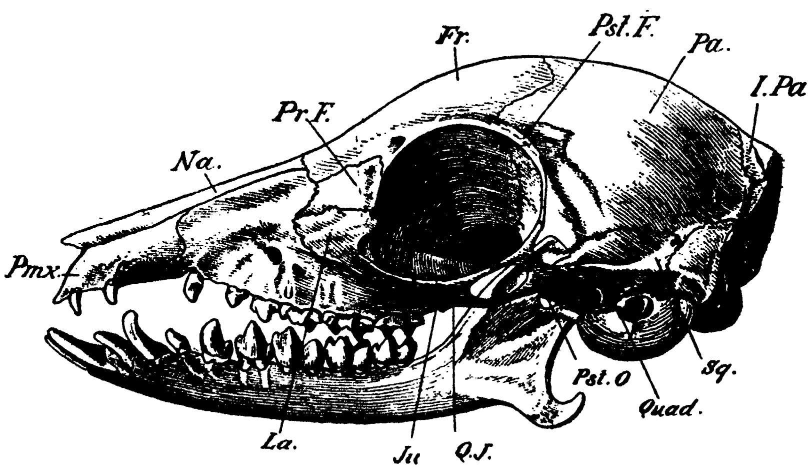

FIG. 4.—TUPAIA. *Fr.*, FRONTAL; *I. Pa.*, INTERPARIETAL; *Ju.*, JUGAL; *La.*, LACHRYMAL; *Na.*, NASAL; *Pa.* PARIETAL; *Pmx.*, PREMAXILLARY; *Pr. F.*, PREFRONTAL; *Pst. F.*, POSTFRONTAL; *Pst. O.*, POSTORBITAL; *Q. J.*, QUADRATOJUGAL; *Quad.*, QUADRATE; *Sq.*, SQUAMOSAL. × 2.

skulls there is what appears to be the remains of a suture running forwards from the anterior border of the fenestra to the maxillary, just below the lachrymo-malar articulation. In no case that I have seen is this suture distinct and clearly defined, but the frequent appearance of a line as if indicating the union of separate ossific centers, points to the existence of separate pieces in the younger stages of development. It may be said of all these sutures above described that their presence is only occasionally indicated in skulls young enough to show the main sutures, but, taken in connection with what we shall presently learn of the development of the human malar, they assume an unusual importance and significance.

What I take to be easily one of the most important of all these newly discovered elements in the skull of the Insectivora is the presence in *Tupaia* and other forms of a small though perfectly dis-

tinct, pointed, more or less rod-like bone, lying upon the inner side of the postglenoid process of the squamosal and the back and inner side of the glenoid articulation. In *Tupaia* it occupies a deep groove at the outer base of the tympanic bulla between the bulla and the base of the squamosal, just in front of the external auditory meatus, and passes forwards and outwards projecting with a free extremity towards the tip of the pterygoid plate of the sphenoid, with which in the recent state it is connected by a separate and distinct ligament. Behind, it passes under or to the inside of the delicate tympanic ring, to overlap the *processus gracilis* or *processus foliatus* of the malleus. In old specimens it is doubtful if it exists as a distinct bone, but has every appearance of fusing with the tympanic ring with little or no trace of the suture left. Just what its relation to the malleus is in old or fully adult specimens I have not been able to determine with certainty, but it appears to remain free. Even in the younger stages it is closely connected to the *processus gracilis* by ligamentous attachment and requires careful investigation to separate it.

There is one other feature of the skull of *Tupaia* which is more reptilian-like than in any other mammal I have seen, and that is the relatively wide separation of the exit of the seventh and eighth pairs of cranial nerves as they enter the periotic. Of the two apertures, that for the seventh or facial nerve is placed above and a little in advance of the lower aperture, the two being separated by a ridge—the *falciform crest* of human anatomy. The foramen for the exit of the seventh nerve has a more or less oval form placed somewhat obliquely, of which the anterior lower part accommodates the facial and is thus the beginning of the fallopian canal, and an upper back part, the office of which I can not now state. On the falciform crest there is a distinct foramen which probably transmits the internal auditory artery. The opening for the eighth or auditory nerve is relatively large and at the bottom cribriform for the passage of the nerve filaments.

Other Insectivora.—Among the Erinaceidae I have been able to find but a single example, and that of a species of *Gymnura*, in which the jugal arch shows any extra elements in the adult stage. In all of them the zygoma is fairly well developed, but the jugal or malar portion is relatively short, occupying the middle part of the arch. There is but a faint indication of a postorbital process of the zygoma, and no postorbital process of the frontal or parietal. In the specimen referred to above (No. 114551) the jugal is divided by a longitudinal suture near the middle into an upper and lower moiety, and having about the same relations to the surrounding bones as in *Rhynchocyon*.

In *Gymnura* (fig. 5) the bone which has been described in *Tupaia* as occupying a position at the junction of the tympanic with the squamosal, just in advance of the external auditory meatus, is

relatively larger than in the latter genus, is flattened and more or less lozenge-shaped; it is pointed at either extremity and broadly grooved upon its superior surface to receive the flattened spatula-shaped *processus gracilis* of the malleus, which lies in intimate contact with it and runs forward upon it to its anterior extremity. Its anterior pointed extremity projects freely from the bulla in the direction of the tip of the pterygoid, and as in *Tupaia* is connected by ligament with that process. Behind it terminates in a sharp point, which lies upon the outer side of the *processus gracilis* of the malleus. This bone in the adult, and I may say in the early adolescent stage, is firmly coossified with the slender tympanic ring, giving to its anterior extremity the appearance of a characteristic three-pronged enlargement. Careful investigation, however, shows that it was originally distinct from the tympanic since the longitudinal striae or grain of the latter bone can be seen crossing upon the outer side of the other at almost a right angle. It terminates in a pointed extremity behind, furnishing the posterior end of the tympanic above, where it is in intimate relation with the base of the *processus gracilis* but not attached to it. Upon its outer side it is produced into a more or less distinct blunt projection which lies just behind the postglenoid process of the squamosal.

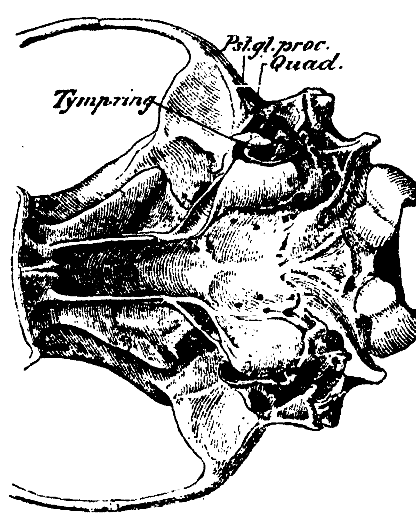

FIG. 5.—GYMNURA. *Pst. gl. proc.*, POSTGLENOID PROCESS; *Quad.*, QUADRATE; *Tymp. ring.*, TYMPANIC RING. × 2.

In the related genus *Hylomys* this bone has a very similar form and about the same relative proportions as in *Gymnura;* it is likewise firmly coossified with the slender tympanic ring, but perfectly free from the *processus gracilis* of the malleus.

In *Erinaceus* I have not been able to identify this element with certainty from any of the materials I have thus far studied. The *processus gracilis* is unusually large, broad, flat, and more or less spatula-shaped at its anterior extremity, where it laps over the expanded tympanic. Parker represents the anterior extremity as divided by a suture in his figure of the embryo,[1] and there seems to be little doubt that this divided extremity represents a separate ossifi-

[1] Philos. Trans. Royal Soc. London, 1886, vol. 176, pl. 12, fig. 11.

...dult or even the half-grown skull all traces ... ...d, and the *processus gracilis* itself later becomes firmly attached to the tympanic ring by bony union.

In *Solenodon* this bone is represented apparently by a long, thin spicule which protrudes forwards from the *processus gracilis*, to which it becomes united in the adult. The *processus gracilis* likewise is firmly united to the tympanic ring.

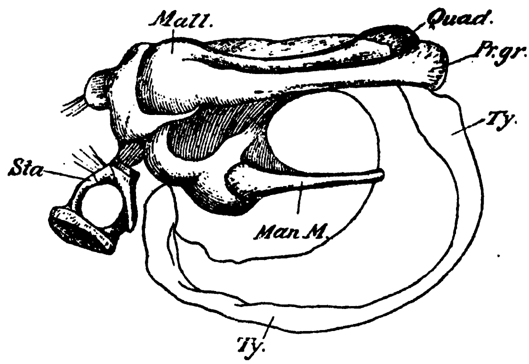

FIG. 6.—ERINACEUS EUROPAEUS. AFTER PARKER. *Mall.*, MALLEUS; *Man. M.*, MANUBRIUM OF MALLEUS; *Pr. gr.*, PROCESSUS GRACILIS; *Quad.*, QUADRATE; *Sta.*, STAPES; *Ty.*, TYMPANIC RING.

In *Centetes ecaudatus* a considerable trace of this bone is left, much as in *Gymnura*, except that it is more reduced in size. It is very distinct from the malleus, but in the adult is coossified with the tympanic. In the embryo Parker represents a large element in this situation [1] which is developed independently in Meckel's cartilage in advance of the *processus gracilis*, and which is separated from the tympanic and the malleus (fig. 7). From the similarity of the appearances of these two elements in *Gymnura* and *Centetes*, coupled with the embryological evidence from Parker just cited, there seems to be no doubt that a separate and distinct element exists. In other members of the Centetidae I have been unable to discover any traces of this element in the adult at least. These include *Hemicentetes*, *Ericulus*, *Microgale*. In a like manner I have found no satisfactory evidence of its existence in any member of the Chrysochloridae, although it may be said that there are no young specimens upon which these observations were made.

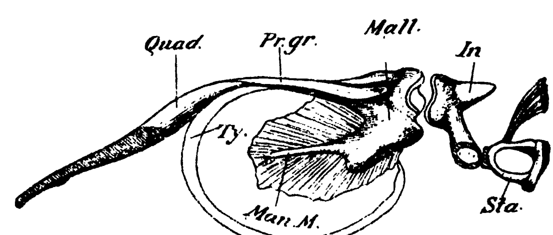

FIG. 7.—CENTETES ECAUDATUS. AFTER PARKER. *In.*, INCUS; *Mall.*, MALLEUS; *Man. M.*, MANUBRIUM OF MALLEUS; *Pr. gr.*, PROCESSUS GRACILIS; *Quad.*, QUADRATE; *Sta.*, STAPES; *Ty.*, TYMPANIC RING.

It is rather surprising that *Galeopterus* should retain so few traces of these features in the adult skull, in view of the many marked resemblances of its skull to that of *Rhynchocyon*. For some unknown reason the skull bones of *Galeopterus* coossify very early, so as to

[1] Philos. Trans. Royal Soc London, 1886, vol. 176, pl. 33, fig. 6.

obliterate all traces of sutures at a comparatively early period. A dearth of material of the proper age prevents a very satisfactory study of the subject in this group, but fortunately some embryos give additional light. The dissection of a young embryo skull shows that the lachrymal ossifies from a single center; that there is a separate center for the postorbital process of the frontal; that there are separate and distinct centers for the jugal, quadrato-jugal, and postorbital of the zygomatic arch. Parker's figures do not show these elements in the embryo, but in my own dissection they can all be distinctly made out. Parker's figures do show, however, that the condylar portion of the lower jaw is made up of a separate piece[1] (fig. 8). My material is evidently of a considerably younger stage than that figured by him and is not sufficiently advanced to make this out very distinctly. As for the element in connection with the malleus and the tympanic I have not found any satisfactory evidence of its presence.

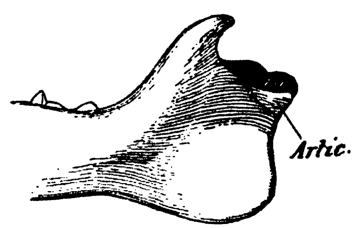

FIG. 8.—GALEOPTERUS PHILIPPENSIS. AFTER PARKER. *Artic.*, ARTICULAR.

Marsupials.—In this group of mammals a number of reptilian characters are met with, similar to those already described in the Insectivora. In the Virginia opossum the embryo skull shows that there is fairly distinctive evidence of the presence of a prefrontal lying near the anterior part of the orbit between the lachrymal and nasal; it shows, moreover, in a rather satisfactory way that the malar of the zygomatic arch is made up of two pieces which ossify from distinct centers, with the existence possibly of a third center at the junction of the squamosal and malar. This latter, however, is not certain. Of the element developed in connection with the tympanic ring and the *processus gracilus*, it may be said that in the fetal skull it develops from a distinct center in the premallear tract of Meckel's cartilage and is separated by suture from the *processus gracilis* up almost to the adult stage, when it usually becomes coosified with the malleus. Not infrequently, however, it remains distinct throughout the life of the animal. It never, apparently, coossifies with the tympanic with which it has the same general relations as already described in the Insectivora.

In other predaceous Marsupials, notably *Sarcophilus*, the *processus gracilis* appears to be made up as in the opossum of an unusually long slender curved rod of bone, which hooks over the tympanic and protrudes forward with a free extremety. Examination of a half-

[1] Philos. Trans. Royal Soc. London, 1886, vol. 176, pl. 38, fig. 4.

grown specimen, however, shows that this bony bar is made up of two separate pieces, as in the opossum, and evidently ossifies from a distinct center in Meckel's cartilage, in advance of the *processus gracilis*. This piece seems to be widely separated from any part of the malleus in the adult skull and is more or less joined to the tympanic.

In the jugal arch of *Sarcophilus* there is some evidence that it is ossified in the same way as in the opossum, namely, from three centers, but I have no embryos young enough to establish this with certainty. There is also evidence that there is a separate bone between the lachrymal and frontal in front of the orbit. Another point of unusual interest in the skull of *Sarcophilus* is the presence of a distinct bone just behind the external auditory meatus at the lower point of junction of the squamosal with the mastoid. This bone, as we shall presently see, is a very constant feature of the skull of the Carnivora, occupying the same position and having the same relations as in *Sarcophilus*. It probably also exists in the Dasyures, but I have not observed it in any other of the Marsupials. It is often met with in *Erinaceus*, however, and probably also in *Centetes*, *Ericulus*, *Solenodon*, and others. As this bone is such a constant feature of many of the Carnivora I propose for it the name of *paramastoid*.

The skull of a young kangaroo in the collection (No. 211) is of especial interest as showing the presence of a free premallear element, consisting of a relatively large triangular piece of bone, overlapping the tympanic, and intimately associated with the forward extension of the *processus gracilis*. This specimen furnishes confirmatory evidence, together with that already noticed in the opossum and *Sarcophilus*, of the statement of Parker, presently to be quoted, that in *Phascolarctos* there is a separate and distinct element developed in connection with Meckel's cartilage in front of the malleus.

The following species of Marsupials in the collection show the presence of an extra element at the junction of the malar with the zygomatic process of the squamosal not dissimilar to that described in *Rhynchocyon*, namely, *Macropus irma* (No. 155372), *Pseudochirus lemuroides* (No. 38714), *Phalanger*, sp. (No. 38470), *Dasyurus maculatus* (No. 38444), *Sarcophilus ursinus* (No. 155385), *Didelphis virginanus* (No. 61842), and *Metachirus opossum* (No. 121414).

Cheiroptera.—Among the fruit-eating bats there are a number of species which show undoubted traces of these archaic characters. In *Pteropus* there are traces of a distinct bone, developed in connection with the postorbital process of the frontal above the eye; there is evidence of a separate element composing the postorbital process of the jugal, as well as less distinct evidence of a division of the malar into two parts. In young skulls there is always a distinct bone developed in connection with the anterior portion of the tympanic ring,

which in adult specimens is coossified with it and with the malleus somewhat as in *Tupaia* and the other forms already described. In many species there is a distinct though small malar foramen.

Edentata.—There are some of the reptilian characters described in the foregoing pages to be met with among the Edentates, although by no means as commonly as among the Insectivora. As there is seldom a postorbital process of either frontal or parietal, no remains of a postfrontal is ever found. On the other hand, however, there is sometimes a rather large bone lying above the lachrymal between it and the frontal, near the anterior border of the eye cavity, in the young skull of the South American species of *Dasypus*. This bone is likewise found in the fetal skull of this species, so that its presence I suspect is not uncommon in the younger stages. In a like manner in *Euphractus villosus*, there is very commonly a distinct ossicle on the rim of the orbit, at the junction of the lachrymal and malar, overlapping the anterior orbital portion of the latter bone. I have met with this element in eight adult skulls of this species, or nearly 50 per cent of the specimens examined. It is of an elongated triangular form and occupies a position on the edge of the orbit. There is more rarely an ossicle developed in the jugal arch, at the junction of the malar and squamosal, corresponding to the postorbital process of the zygoma, but I have not found traces of this ossicle in the embryo of *Dasypus*.

The ossicle developed in connection with the tympanic ring and the *processus gracilis* of the malleus, occurs as a distinct element in the South American *Dasypus*, in *Tamandua*, and very probably in *Cyclopes*. Indications of its presence are likewise to be seen in the Aard Vark and other species of Edentates. Those species in which the tympanic ring is little expanded, like so many other forms, show it most distinctly, while in those in which the tympanic is inflated to form an osseous bulla, it disappears by coossification with this latter bone, and is not found in the adult skull.

Parker's statement, as well as his figures of this element in the embryo of the two-toed sloth, *Choloepus hoffmanni*,[1] are of unusual interest and importance as establishing beyond question the fact that there is not *one*, but at least *two*, extra elements developed in the premallear tract of Meckel's cartilage in this form. I here reproduce Parker's figure of that part of this interesting embryo (fig. 9). I have not been able to find any trace of these ossicles as separate elements in the adult skull, but there is very distinct evidence of their having coossified with the tympanic. Upon the interior wall of the tympanum is a relatively large, more or less triangular piece of bone lightly attached at its back part to the periotic by a very thin bony

[1] Philos. Trans. Royal Soc. London ,1886, vol. 176, p. 65, pl. 9, fig. 7.

spicule. This may be the remains of the enlarged portion of these elements figured by Parker.

Sirenia.—The American sea cow shows at least three elements in the jugal arch in the adult skull—namely, a quadrato-jugal piece, articulating with the zygomatic process of the squamosal, a jugal element underlying the orbit, and a post orbital piece which forms the postorbital process of the arch. There are, in addition to these, in some specimens, a small ossicle developed just above the vestigial lachrymal and a pair of ossicles lying below and upon the outer side of the reduced nasals. As there is no postorbital process of either frontal or parietal, no trace of a separate element in this situation is found. In all of the specimens which I have thus far examined I have been unable to detect the presence of an element associated with the tympanic, which corresponds to that already described in *Tupaia*, *Gymura*, and others, although from certain appearances of the dried skull, it is not altogether unlikely that carefully prepared younger specimens may show its presence.

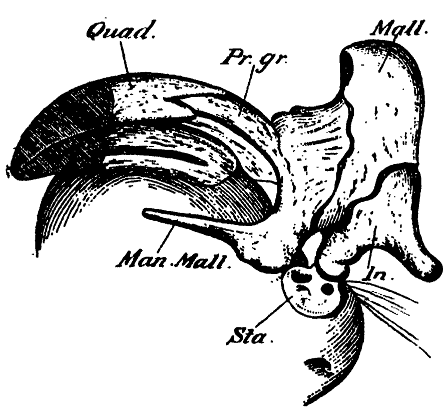

FIG. 9.—CHOLOEPUS HOFFMANNI. *In.*, INCUS; *Mall.*, MALLEUS; *Man. Mall.*, MANUBRIUM OF MALLEUS; *Pr. gr.*, PROCESSUS GRACILIS; *Quad.*, QUADRATE; *Sta.*, STAPES.

Ungulata.—Among the Ungulates the horses show the presence of at least two elements composing the malar in the younger stages, one of which represents the jugal and the other the quadratojugal. It is more than likely also that the bony bar bounding the posterior part of the orbit is composed of an upper and lower element in the young stages, although I have not seen the evidence to confirm this.

Rodentia.—The chief point of interest in this group as far as the presence of these reptilian elements is concerned relates for the most part to the composition of the zygomatic arch. There is considerable evidence in both the Hystricoidae and the Sciuroidae that there were originally at least two elements entering into the arch, namely, a jugal which has disappeared in many forms and the quadrato-jugal, which now constitutes the principal remaining piece. In the squirrels that part of the long malar which runs forward to the lachrymal along the under edge of the orbit is sometimes cut off by a suture into a distinct bone, as is likewise the case somewhat more frequently in the Hystricoidae.

Lagomorpha.—In the Lagomorpha the maxillary seemingly runs backwards behind the glenoid cavity and forms the whole of the zygomatic arch. Sufficiently young skulls show, however, that this appar-

ent backward extension of the maxillary is in reality a distinct element that is separated by suture and represents the quadrato-jugal. The jugal, as well as any representative of the postorbital are apparently missing in the adult. This interpretation of the zygoma of the Lagomorpha gives a clue to the composition of the arch in *Ornithorhynchus*, which is without much doubt made up of the usual three elements. I can not accept the interpretation figured by Broom,[1] since there is pretty clear evidence from a fairly young skull in the collection that the lower piece of the arch is separated by suture from the maxillary and is therefore the quadrato-jugal. The bone figured by him as the jugal is much more likely to be the postorbital. In embryo skulls the jugal may be present.

Carnivora.—In the composition of the jugal arch the Carnivora not infrequently display evidences of the compound nature of the so-called malar. Thus a large percentage of the skulls of bears show the postorbital process of the zygoma to consist of a distinct element, the suture separating which is very frequently more or less evident. This is likewise often seen in the various species of the Felidae. In some 8 or 10 fetal skulls of blue foxes the anterior part of the zygomatic process of the squamosal is cut off as a distinct piece, which I take to represent this same element composing the postorbital process of the arch in the Canidae. The same division is sometimes found in the adult skull, and has been figured by me in the extinct Creodont *Dromocyon vorax*.

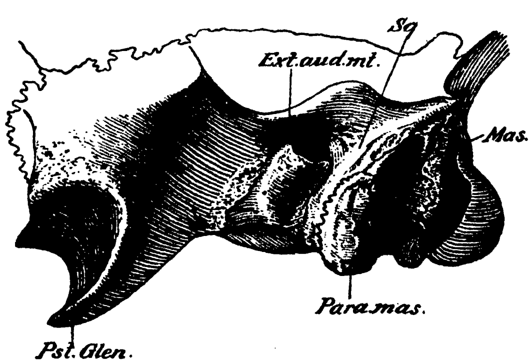

FIG. 10.—URSUS HORRIBILIS. *Ext. aud. mt.*, EXTERNAL AUDITORY MEATUS; *Mas.*, MASTOID; *Para. mas.*, PARAMASTOID; *Pst. Glen.*, POST-GLENOID; *Sq.*, SQUAMOSAL.

At the junction of the squamosal and the mastoid, near the lower end and just posterior to the external auditory meatus is a distinct bone, which is so constant in the bears as to be almost a distinguishing feature of this group. It sometimes exists as a cap or epiphysis, but in other instances it is united by strongly dentate suture. A similar element is found in the Mustelines, raccoons, and many other species of Carnivora with great frequency. As already noted the same element is seen in certain of the Insectivora and Marsupials. On account of its possible important relationship with the quadrate I propose a name for this bone, already suggested on a former page (14), namely, the *Paramastoid* (fig. 10).

[1] On the Structure and Affinities of the Multituberculata. Bull. Amer. Mus., 1914, p. 130.

Of the existence of a separate element in advance of the malleus it may be said that there is a pointed spicule protruding under the upper edge of the tympanic in the civets, apparently most distinct in *Paradoxurus*, and in the otters among the Mustelines, which, from what we have already seen in so many other species of mammals, probably indicates its presence. I have not been able to determine its exact relations with the *processus gracilis* in these forms.

Primates.—Comparatively few of the reptilian elements described in the foregoing pages are to be seen in the adult skull of the primates, notwithstanding the embryological evidence seems to be very conclusive that they are to be seen in the early stages of development. We thus find three centers of ossification for the malar; one for the postorbital process of the frontal, one between the lachrymal and frontal, and one alongside the nasal spine of the frontal. All these centers of ossification can be easily interpreted on the basis of reptilian anatomy. As we shall presently see, the malar foramen, which is unusually large in some of the primates, is likewise, in all probability, the vestige of an important opening in the reptilian skull.

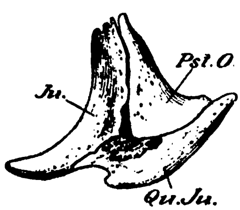

FIG. 11.—HOMO SAPIENS. AFTER TOLDT. *Ju.*, JUGAL; *Pst. O.*, POSTORBITAL; *Qu. Ju.*, QUADRATOJUGAL.

In studying the ossification centers of the human malar I have found it very difficult to distinguish the sutures separating them when seen from the outside, but when they are viewed from the inside they are much more evident on account of the lack of scale-like overlapping upon the inside of the arch. Evidence of the original separation of at least two of these pieces persists until as late as the seventh month of fetal life, while from the outside they always appear to be fused by the end of the third month. I here reproduce Toldt's figure (fig. 11) of the malar of a seventh month fetus,[1] which shows this well. In the young stages the malar foramen is not easily distinguished. There seem to be a number of openings through the malar, some of which disappear as age advances. Just which one of these finally becomes the malar foramen or foramina I have been unable to determine with satisfaction, but it would seem that the foramen which remains is developed near the edge of the orbit and is apparently not homologous with the large opening found in certain other primates, notably in the spider monkeys, howlers, and teetes of South America, and in some of the Madagascar lemurs. There seems to be a great deal of variability in this opening among the primates.

The divided malar in the human skull, which occurs not infrequently as an anomaly,[2] represents the lower or quadrato-jugal element of many mammals in which it remains distinct. In a young

[1] Die Zerteilung des Jochbeines und andern Varietaten desselben, Sitzungsber. kais. Akad. Wissensch Wien, 1903, pl. 1, fig. 5.

[2] See also Aleš Hrdlička, Amer. Naturalist, 1902-1904.

skull of *Nycticebus* (No. 142240) and of a *Perodicticus* (No. 184229) this lower piece is shown on both sides with the remains of the suture distinct. In the South American primates with the large malar vacuity, when the malar consists of more than a single piece, the parts are arranged in such a way as to radiate from the malar opening.

Not infrequently there is a suture in certain species of South American apes, cutting off that part of the malar which lies upon the orbital rim, below and to the outside of the eye cavity, and less frequently an element which lies behind the malar foramen near the junction of the malar with the squamosal. In a like manner there is often evidence of a distinct element extending from the supraorbital foramen to the junction of the malar, upon the upper and outer edge of the orbital rim. I can find no traces of a premallear element nor paramastoid in any specimens of primates which I have examined.

Monotremes.—The skull of the duckbill (*Ornithorhynchus paradoxus*) exhibits a number of features which are of great interest in connection with the present study. On account of the early coossification of nearly all the cranial bones and the obliteration of the sutures it is not easy to determine their limits and relations from the ordinary museum specimens. The only figures purporting to give this information are from Van Bemmelen [1] and Broom,[2] but these are so different from that of a fairly young specimen in the collection that I have deemed it advisable to give the interpretation of certain of the elements as afforded by this skull.[3] The zygomatic arch as here shown is composed of the three elements already described in *Rhynchocyon*, and while there may be some doubt in regard to the division of what appears to be the long zygomatic process of the squamosal running forwards to the postorbital process of the arch, yet the specimen shows what appears to be the remains of a suture in the situation where it should appear. The supposed backward extension of the maxillary process to the glenoid articulation in the lower part of the arch, as figured by Broom, is shown to be a distinct element separated from the maxillary by a well-marked suture.

That which is the most important and interesting feature of the skull before us, however, is an indication of the presence of a relatively large distinct bone lying just internal to the glenoid cavity, between it and the periotic; it projects downwards and backwards and the appearance of the surface of its lower free extremity so closely resembles that of a synovial joint that there is apparently no mistaking its significance. This piece is distinctly separated by well-marked suture from the squamosal, the exoccipital, and the alisphenoid, but in the present specimen not completely cut off from the periotic. If it is not distinct from this latter bone in the still

[1] Ueber den Schädel der Monotremen, Zool. Anz., 1901.

[2] Structure and Affinities of the Multituberculata, Bull. Amer. Mus. Nat. Hist., 1914, p. 130.

[3] Watson's paper was received too late for use in this connection.

younger stages, then I can not understand why it should be in the present specimen partially, and I may say almost completely, separated from it by suture which shows alike on the two sides. By its upper posterior extremity it articulates with the squamosal and exoccipital, there being no mastoid portion of the periotic exposed in this region of the skull that I can find. In front it is produced into a more or less pointed free extremity directed forwards and inwards toward the pterygoid. It is attached above to the periotic.

Scarcely less interesting than the foregoing is the presence of a relatively large foramen or vacuity passing from behind forwards just above the glenoid articulation, being bounded above and on the outside by the squamosal, on the inner side by the exoccipital, and below by the exoccipital and squamosal. The parietal above does not enter into the formation of this vacuity, but reaches down almost to its upper boundary. In the curious rodent *Lophiomys* this vacuity is represented in part. Instead of running forwards entirely above the articulation, as it does in *Ornithorhynchus*, it enters just back of the joint and has the periotic for its internal boundary. A large venous foramen in the Marsupials in this situation may represent the remnant of the same structure in these forms.

Homologies of these supernumerary bones.—From a careful consideration of the foregoing facts, what conclusions or deductions can be drawn as to the homologies of these elements, and what light do they throw upon the broader problems of the descent of the Mammalia from the Batrachia or Reptilia? With the rather incomplete embryological evidence which we have I think we are justified in assuming that the occurrence of such characters in *Rhynchocyon* as above described, even though they may be largely obliterated in the adult skull, and are only occasionally to be met with in exceptional specimens, is none the less very strong presumptive proof that these vestigial structures represent separate and distinct elements in certain mammalian skulls, at least, which were once to be found in practically all stages and ages, just as in the Reptilia. As to the frequency of the occurrence of these remarkable features of the skull in *Rhynchocyon* I have little or no additional evidence to offer, further than that furnished by the figures of the skull by Peters [1] of *Rhynchocyon cirnei*, in which some of the sutures, at least, delimiting these elements are represented. There can be little doubt that if his specimens were carefully studied with the object in view of determining this point, they would offer conclusive confirmatory evidence of the facts above set forth. At all events, in the light of such embryological testimony as we have, respecting the presence of certain of these elements in the Mammalia, we may, in my judgment, safely conclude that when

[1] Naturwiss. Reise nach Mossambique, 1852, pl. 13.

this evidence is fully known in the case of *Rhynchocyon*, it will be in no wise different.

It is stated in Cunningham's Human Anatomy [1] in speaking of the ossification of the malar, "the malar ossifies in membrane most probably from three centers, disposed as follows: One in the posterior part of the bone, the other two in connection with the orbital process and orbital margin. Appearing as early as the eighth week, these centers are confluent by the beginning of the fifth month of fetal life." Again, it is stated in Gray's Anatomy, Spitzka, 1913, in speaking of the same subject: "The malar bone generally ossified from three centers, which appear about the eighth week—one for the zygomatic and two for the orbital portion—and which fuse about the fifth month of fetal life. The bone is sometimes, after birth, seen to be divided by a horizontal suture into an upper and larger and a lower and smaller division."

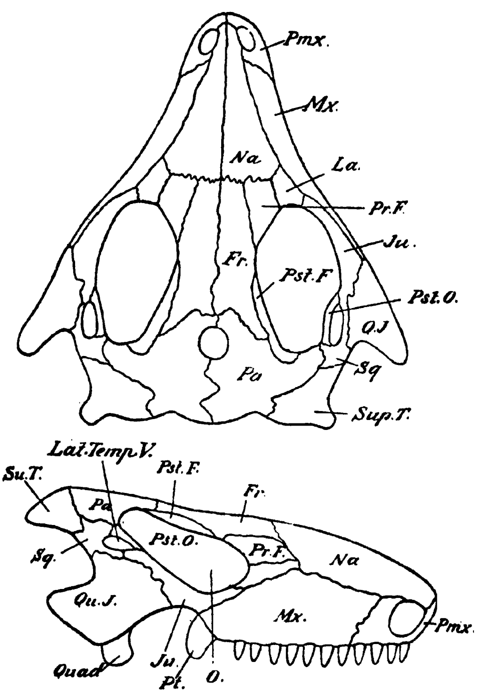

FIG. 12.—PROCOLOPHON TRIGONICEPS. AFTER SMITH WOODWARD. *Fr.*, FRONTAL; *Ju.*, JUGAL; *La.*, LACHRYMAL; *Lat. Temp. V.*, LATERAL TEMPORAL VACUITY; *Mx.*, MAXILLARY; *Na.*, NASAL; *O.*, ORBIT; *Pa.*, PARIETAL; *Pmx.*, PREMAXILLARY; *Pr. F.*, PREFRONTAL; *Pst. F.*, POSTFRONTAL; *Pst. O.*, POSTORBITAL; *Pt.*, PTERYGOID; *Quad.*, QUADRATE; *Qu. J.*, QUADRATOJUGAL; *Sq.*, SQUAMOSAL; *Sup. T.*, SUPRATEMPORAL.

Taking first the bone developed in connection with the postorbital process of the parietal, in *Rhynchocyon*, at the upper and back part of the rim of the orbit, it is to be observed that it not only occupies the same position, but is very much alike in form to the corresponding bone in certain reptilian skulls. This element is therefore to be homologized with the *postfrontal* of the reptile. This is its exact position in such a reptilian type as *Procolophon trigoniceps*, of the South African Karoo bed (fig. 12), as figured by Smith Woodward.[2] It is important to note, moreover, that it has the same general shape in the two, being a long slender bone, occupy-

[1] Article, Osteology, by Arthur Thompson, 1902, p. 133.
[2] Vertebrate Paleontology, 1898, p. 149.

ing the upper edge of the orbital rim, overlapping the junction of the parietal and frontal, and passing down upon the outside of the depending process of the parietal, which goes to make up the principal part of the postorbital process above. As already pointed out, *Rhynchocyon* is in this respect wholly unique among the Mammalia, being the only form which to my knowledge has retained in its entirety this primitive reptilian feature, as displayed so perfectly by the extinct reptilian genus above mentioned. I shall refer to this subject on a subsequent page. Of the exact homology of this element in the two forms, I do not think, therefore, that there can be the slightest question or the faintest doubt.

If the element above considered be the true representative of the *postfrontal* of the reptilian skull, then the element lying below it in the jugal arch, forming its postorbital process, can be no other than the *postorbital* bone, since its position is almost if not exactly the same as in *Procolophon*. Its form, moreover, when compared with the corresponding element in this extinct reptile, is seen to be strikingly similar. Its relations at its lower end are almost exactly alike in the two forms, lying upon the upper side of the arch, near the junction of the squamosal and jugal. In *Rhynchocyon* it terminates above in a free extremity, while in *Procolophon* it extends upward to join the depending process of the parietal (postorbital process) and the squamosal. It would require but a slight extension of the bone upward in *Rhynchocyon* to meet this downward projecting process of the parietal to produce almost the exact relations above as found in *Procolophon*. It is of course to be taken into consideration that the change from the reptilian to the mammalian condition has produced considerable alteration in relations of certain parts of the squamosal. In *Rhynchocyon* the upper part of the *postorbital* is reduced and it has lost all contact with the squamosal above, as shown in *Procolophon*. That it was formerly larger in *Rhynchocyon* or its ancestors and may have joined either the postfrontal or the parietal, or both, is not altogether unlikely, but whatever the former relations of its upper end may have been does not affect the main question of its homology with the *postorbital* element of the reptilian skull.

In a like manner the element composing the lower part of the arch, and extending from the maxillary in front to the glenoid cavity behind, I homologize with the *quadrato-jugal* element of reptilian anatomy, for the reason that its general and usual relations among the Reptilia are of this character. It thus has the squamosal above, the quadrate below, behind, and to the inner side, and the jugal in front and above. With the disappearance of the quadrate it has been shifted forward somewhat and has developed a connection with the maxillary, which it does not seem to have in the reptilian

skull, but it still clings to its original position, as far as its relations to the squamosal, jugal, and, as we shall presently see, to the quadrate, are concerned. In *Procolophon* the quadrato-jugal is a relatively large deep bone, and the similarity of this element in the two forms is not very close. Its position corresponds in the two, however, almost exactly.

By exclusion, therefore, the remaining element entering into the composition of the jugal arch in *Rhynchocyon* must represent the *jugal* bone of the reptilian skull. Its position and relations are again in strict accord with the corresponding element in *Procolophon* and other Reptilia, namely, it lies above the quadrato-jugal at its posterior end, it passes under the edge of the squamosal behind, and in front it forms the lower edge of the orbit, overlying the posterior end of the maxillary and passing forward on the orbital rim to join the lachrymal. All these relations, it may be added, are typically reptilian.

In view of the uncertainty of a division of the lachrymal by the imperfect suture above described, in connection with that bone, it may not be wise, with the present material, to attempt to establish any homology with a distinct reptilian element. However, if the embryology or the development of the lachrymal in *Rhynchocyon* finally shows it to be derived from two centers, as this suture would seem to indicate, then in that event the upper element lying between the frontal and lachrymal would undoubtedly have to be homologized with the *prefrontal* or *adlachrymal* of the reptilian skull and the lower piece containing the lachrymal canal would represent the true lachrymal.

If this latter homology is established, what, then, is the significance of the small bone lying at the junction of the frontal, lacyrhmal, and maxillary on the side of the face? Its backward extension by a pointed extremity toward the rim of the orbit would seem to indicate a former position in connection with the eye cavity, and as it lies above the lachrymal I have been disposed to consider it homologous with the prefrontal of the reptilian skull. The relatively large size and a position much nearer the orbit of a bone which is occasionally seen in *Dasypus*, as already described, would seem to favor this view. On the other hand, as we have already seen in the Sirenia, there is a pair of ossicles lying above the lachrymals, between them and the frontals, which undoubtedly represent the *prefrontals* for reptiles, and an additional pair, lying upon the outside, and below the vestigial nasals, which I take to represent the *septo-maxillaries* of many reptiles, of the monotremes, and *Tritilodon*, as figured by Broom. It may be possible, therefore, that the bones in question in *Rhynchocyon* may represent the septo-maxillaries, but their wide separation from the nasals would be against this interpretation. Whatever elements

they may represent in the reptilian skull, the same interpretation must be given to them in *Lemur*, in which they sometimes occur in the same position as in *Rhynchocyon.*

Parker in his notable work on the morphology of the skull in the Insectivora,[1] figures an embryo skull of *Rhynchocyon cirnei*, but the stage apparently is too advanced to show the centers of ossification of the lachrymal, which is represented as completely ossified without any trace of sutures. From what I know of the ossification of the lachrymal in the fetal skull of *Tupaia* I should say that it would require a considerably younger stage to show whether there are one or more centers in *Rhynchocyon.* It is not clear from his figures whether there is a distinct postfrontal or not, but it would appear so from the side view of the skull. In a like manner there seems to be a large distinct prefrontal represented between the lachrymal and frontal near the orbital margin, a fact which seems to strengthen the evidence in favor of the view that the corresponding bone in the adult skull, as described above, is a true homologue of the prefrontal. If upon further investigation it is found that the lachrymal ossifies from two centers, as it does in *Tupaia*, then one of these extra elements would have to be interpreted as a supraorbital. He does not represent the zygomatic arch as divided into the three elements as shown in the adult skull of *Rhynchocyon petersi* above described, nor does he say anything in the text about any of these bones. The lack of information upon these important points is upon the whole rather disappointing in a work of such magnitude.

The homologies of the ossicles found in connection with the lachrymal in the other genera of the Macroscelididae, notably those of *Cercoctenus sultana* and *Petrodromus tetradactylus*, are less certain of identification as reptilian elements. In view, however, of the apparent complete absence of any other trace of a true jugal element in some very young skulls of these species, it is not altogether unlikely that the ossicle occurring at the junction of the lachrymal with the remaining element of the zygoma may represent the vestigial or reduced true jugal, which was originally larger and occupied a more posterior position on the orbital rim, being now represented by its anterior portion alone. In that event the principal element in the jugal arch would be homologized as the quadratojugal. In a like manner the upper ossicle attached to the lachrymal may represent a prefrontal or supraorbital element which has been crowded out, and has finally come to occupy a position on the edge of the lachrymal. If this explanation be correct, it then follows that all lachrymal crests, tubercles, protuberances, etc., so frequently seen in the skulls of Marsupials, Insectivores, Rodents, and many other groups, are to be interpreted in the same way and probably

[1] Philos. Trans. Royal Soc. London, 1886, vol. 176, pl. 36.

represent the final stages in the coalescence of these elements, which remain free in the Macroscelididae.

As regards the Tupaiidae the evidence in favor of the undoubted presence of certain of these reptilian elements, while it is not quite so direct and positive as it is in *Rhynchocyon*, is nevertheless very suggestive. That the so-called postorbital process of the frontal represents a distinct element is not susceptible of absolute proof at present, yet there is considerable evidence in favor of such a view. The single embryo skull of *Tupaia* which I have dissected was unfortunately of too young a stage to show many of these points clearly, but there is some evidence of a separate center, lying behind the supraorbital foramen, which begins to ossify much later, apparently, than the other bones of the skull. This is likewise true of the bones of the jugal arch and squamosals, since in the embryo above referred to no ossification in these elements had yet started. The lachrymal, however, had begun to ossify and it is of great interest to note that it starts from *two centers*, one below surrounding the lachrymal canal and the other above adjoining the frontal. The evidence is conclusive, therefore, that this latter element represents the prefrontal of the reptile.

In regard to the bones surrounding the so-called malar foramen the only direct evidence as the case now stands is based upon the anomalies already described; but when we take into consideration the embryological evidence derived from the human malar quoted above, from the adult condition shown in *Rhynchocyon*, the evidence from the embryo of *Galeopterus*, the embryo of the opossum, the young skull of the sea cow, as well as those of so many other mammals, the assumption is warranted that there are three elements represented in the jugal arch of *Tupaia*, corresponding to the jugal, quadrato-jugal, and postorbital bones of the reptilian skull, and that they are, moreover, disposed around the malar foramen and form its boundaries quite in the same way as they do in certain of the primates. If this so-called malar foramen is thus surrounded by and forms the central meeting point of these three bones, then the interesting question arises as to its homology. That it is not a foramen in the ordinary sense is shown in *Tupaia* by its large size in proportion to the relatively small size of the structures which it transmits. This same condition is seen in many apes.

A careful comparison of this malar foramen, as thus bounded in *Tupaia*, with the lateral temporal vacuity of such a reptilian type as *Procolophon* reveals a surprising degree of similarity. Thus it will be seen that in both it is placed below and more or less posterior to the orbital cavity, it has an oval form and is near the beginning of the jugal arch. In *Procolophon* a small sliver of the squamosal excludes the upper part of the quadrato-jugal from taking any share

in its boundary and the squamosal furnishes the principal part of the boundary behind, but with the great changes that have occurred in this latter bone in the transition from reptile to mammal it is not surprising that the vacuity should have been shifted forward slightly and the squamosal entirely withdrawn from its boundary. In *Tupaia* the anterior end of the zygomatic process of the squamosal lies just behind it, and the change from the relations exhibited in *Procolophon* to those seen in *Tupaia* would be very slight indeed.

Upon the whole, therefore, the presumption that the so-called malar foramen of *Tupaia*, of certain of the primates, and possibly of the fruit-eating bats, is the remains of the lateral temporal vacuity of the reptilian skull, finds a fair and reasonable measure of support.

The homology of the vacuity lying just above the temporo-mandibular articulation described in the Monotremes is not difficult to discover when we compare it with such a type as *Sphenodon*. In this latter form the large opening from the temporal area on each side of the braincase, which is directed backwards (the supraoccipital vacuity) has for its boundaries above the squamosals and parietals, and below chiefly the exoccipitals. As will have been noticed in the description of this aperture in the duckbill's skull this is almost the exact boundary there seen. The only difference is that in *Sphenodon*, because of the small brain case the parietal enters into the bounding arch above, while in the Monotremes, owing to the enlargement of the cranial cavity, the parietal has been excluded, and the outer part only of the vacuity in the reptile skull is represented in the mammal. This homology is so clear and unmistakable that there is no room for doubt as to its correctness. If this conclusion is correct then the similar opening seen in certain Rodents, notably in *Lophiomys* and in the Marsupials is the inconsiderable remnant of the same supraoccipital vacuity of the reptilian skull.

Fate of the Reptilian quadrate in the Mammalia.—The determination of the homology of the premallear element or elements described in the foregoing pages involves a discussion of some of the most important problems connected with the morphology of the mammalian skull. The great question, "What has become of the quadrate?" in the evolution from the reptilian to the mammalian condition has fretted the minds of philosophers and baffled the best brains of morphologists for the last 50 years without any generally accepted and satisfactory answer. Without attempting to go into the extensive literature on the subject and follow out in detail the various theories that have been advanced, it must suffice here to say that the subject has finally settled down to two rival theories—namely: (1) The reptilian quadrate has been detached from its original position as a suspensorium of the lower jaw, has been much reduced in size, and has become the middle element of the ossicular chain of

the tympanic cavity, namely the incus. The articular of the reptilian mandible has lost all connection with the lower jaw and has become the malleus of the mammalian ossicular chain. (2) The auditory chain of bones of the mammalian tympanum have been derived from and are strictly homologous with a similar chain of bones in the reptilian or batrachian skull frequently found as an undifferentiated rod of bone, the *collumella auris*. The quadrate has disappeared, having become either the tympanic (Gadow), the inter-articular fibro-cartilage of the glenoid cavity (Broom), or incorporated with the squamosal (Cope and Baur).

When one studies the quadrate in a large series of reptiles and birds he can not well avoid being struck with the superficial resemblances of this bone to the mammalian incus. This is heightened by the peculiar manner in which the quadrate articulates in birds and is attached to the side wall of the brain case by a ball-and-socket joint, not dissimilar to the way in which the short process of the incus is received into the *fossa incudis* of many mammals. Then, again, there is the peculiar and wholly characteristic double saddle-shaped articulation of the incus and malleus of the mammalian tympanum, which at once recalls the articulation between the quadrate and articular of the reptilian jaw, and lastly the relatively large size of the incus and malleus in certain of the lower forms of the mammalia, notably the monotremes. Another supposed fact which has been looked upon as having an important bearing upon the question and used in support of this hypothesis is the assumed complete absence of any representative of an articular element in the mandible of the mammal. This is stated by Gregory[1] as follows:

"In order to substantiate the conclusion that the mandibulo-squamosal joint in mammals is a wholly new structure, into which the quadrate and articular did not enter, we recall the facts (1) that embryological research gives no warrant for the belief that the mammalian jaw is composed of more than one element (except for the occasional vestiges of a splenial); (2) that all the oldest known mammalian jaws, from the Triassic, Jurassic, and Basal Eocene, never show any trace of sutures; (3) that in the Cynodonts the broad ascending ramus or corono-condylar region appears from Broom's researches to be a part of the dentary."

For the sake of brevity this theory may be called the transposition theory of the quadrate and articular.

The other theory of the fate of the reptilian quadrate in the mammalian skull assumes that it has gradually disappeared without having entered the tympanic chain; that the *ossicula auditus* of the mammalian tympanic cavity have been derived directly from a

[1] The Orders of Mammals, Bull. Amer. Mus. Nat. Hist., Feb., 1910, p. 138.

similar chain of bones in the promammalian reptiles or batrachians; that the articular has likewise in many instances been gradually crowded out and lost, its function having been usurped by the condyloid process of the dentary; that this same fate has in varying degree befallen the other jaw elements of the reptilian skull, save the dentary and splenial. In contradistinction to the transposition theory of the quadrate and articular this latter view may be called the absorption theory of these elements.

A consideration of the fate of the reptilian quadrate in the mammalian skull necessarily involves a discussion of the fate of the other elements of the reptilian jaw as well, since there can be little difference of opinion apparently that the mammalia have been derived by descent from the reptilia or batrachia, and that through some changes which are attempted to be explained by these various hypotheses the present state of affairs has been brought about in the mammals. If the quadrate has been transposed from its original position as a suspensorium of the lower jaw and transferred to the mammalian auditory chain, having its function completely altered, and the articular has been transformed into the mammalian malleus, as claimed by the advocates of this view, then a concomitant postulate which may be said to be absolutely vital to this hypothesis, is the complete and total absence of any element or homologous part in the mammalian jaw representing the reptilian articular. For if it can be shown that any element corresponding to this bone in the Reptilia is ever found in any mammal, then the whole theory falls and can not be considered to be explanatory of the fate of the quadrate, since it is utterly inconceivable how this latter bone could have ever been independently intercalated in the middle of a chain of bones connecting the eardrum with the fenestra ovalis, and which by common consent, all are agreed, have always been concerned in performing the highly important function of audition.

Another very vital matter involved in a discussion of this subject relates to the origin and manner of ossification of the various bones herein considered, for without a clear and definite understanding of just what is meant by the terms employed, as well as a precise and intimate knowledge of the histological processes by which these bones are developed, we shall never be able to make any satisfactory progress toward a final solution of the problem before us. It is very easy to speak of cartilage bones, membrane bones, splint bones, etc., as if they were perfectly and obviously distinct entities and to base important and far-reaching hypotheses upon a lax understanding of the subject, but can we always be sure that such conclusions are sound? That there are broad and well-marked distinctions between the various categories of ossifications, in their typical development, is undoubtedly true, but at the same time the fact must not

be overlooked that there are many cases in which it is difficult if not impossible to decide to which particular category a given bone is to be assigned because of the intergradation of the various processes involved in its production or development.

Parker in his consideration of the osseous skull of the vertebrates makes the following classification:[1] "Calcareous deposit occurs in vertebrates in the following tracts: (1) Epidermis or epithelium (enamel of the teeth, and outer layer of Ganoid scales); (2) dermis (dentine of teeth, Ganoid and Teleostean scales); (3) subcutaneous fibrous mesh, immediately outside the perichondrium, and eating into cartilage (ectostosis); and (4) deep in its substance (true endostosis, central or subcentral). In most of these tracts the calcification may be such as not to gain the title of bone; but in all except the first, true bone may result from the process."

While this classification is in the main correct and in general accord with the more modern views of the subject, it is at the same time hardly explicit enough to serve our present purposes. According to the researches of histologists the formation of bony tissue, outside of Parker's first group, is divided into two categories, namely, an *intramembranous* and an *intracartilaginous* ossification. The chief and most important distinction between these two catagories is that in the former there is no cartilaginous mold or matrix which precedes the appearance of the bone tissue; while in the latter a cartilaginous mold or matrix is always present. In the intramembranous division, the membrane which occupies the place of the future bone consists of white fibrous connective tissue and ultimately forms the periosteum from which the osteoblasts are derived. At first a series of fine bony spicules are seen radiating from the point or center of ossification, known as the *osteogenetic* fibers, which are deposited under the influence of the osteoblasts. As these osteogenetic fibers grow out to the periphery they continue to ossify and give rise to fresh bony spicules. Subsequently successive layers of bony tissue are deposited beneath the periosteum and around the larger vascular channels, so that the bone increases much in thickness. It is further stated that the process of bone formation spreads laterally to the future suture, and here between the various bones a layer of fibrous tissue, the *cambium layer*, is maintained until the full size of the bone is reached. The cambium layer then ossifies and the bone ceases to grow at its edges. The persistence of this cambium layer and its failure to undergo final ossification is the cause of the maintenance of the sutures between bones which so frequently results in the anomalies which have been discussed in the preceding pages.

In the intracartilaginous method of ossification, on the other hand, as already stated, the future bone is preceded by a cartilaginous mold

[1] Morphology of the Skull, 1877, p. 343.

or matrix. The first step in bone formation in this manner consists in the multiplication and enlargement of the cartilage cells and their arrangement in rows at the center of ossification. The matrix in which they are imbedded increases in quantity so that the cells become farther separated from each other. A deposit of calcareous material then takes place in this matrix, between the rows of cells, so that they become separated from each other by columns of calcified matrix. These columns are connected by transverse bars of calcareous substance. While this process is going on within the substance of the solid cartilage of which the developing bone consists, certain changes are taking place on its surface. This is covered by a very vascular membrane, the *perichondrium*, entirely similar to the connective tissue layer, which forms the basis and constitutes the periosteum of membrane bone. On the inner surface of the perichondrium the cells become osteoblasts or bone-forming cells, through the agency of which a thin layer of bony tissue is being formed between the outer membrane and the cartilage, in a manner not dissimilar to that in which the formation of true membrane bone takes place. The two processes above described go on simultaneously in the development of cartilage bone. The second stage consists in the prolongation into the cartilage of processes of the deeper or osteogenetic layer of the perichondrium, these processes consisting mostly of blood vessels and osteoblasts. In this way the bone is gradually built up and finally reaches its adult condition. It will thus be seen that practically the only difference between a cartilage and a membrane bone consists in the presence of a cartilaginous mold or matrix, which precedes the former in the order of its development; but it frequently happens that a cartilaginous mold may be present, yet the resulting bone may be formed almost exclusively from the perichondrium without involving the cartilage to but a very small extent. There can be little doubt that if this subject were to be followed up carefully all kinds of intermediate conditions would be found connecting these processes of bone formation quite closely, save and except the presence or absence of a perachondrial mold or matrix. It frequently happens, moreover, that in some bones both processes are concerned in its formation, and that one portion of the bone may be formed by one method and another portion, in part, at least, by the other.[1]

[1] Huxley in his article on the Amphibia, quoted below, in speaking of the cranial bones of *Rana* says: "The ex-occipitals, prootics, and sphen-ethmoid are ossifications which involve the chondro-cranium, though they largely consist of secondary bone." And while he does not state directly that this is likewise true of the quadrate, we are left to infer as much from his further statement. Again, in speaking of the long bones, he says: "The long bones, both in the fore and hind limbs, consist of an axis of cartilage, sheathed in, and more or less replaced by a diaphysis of membrane bone." We may regard the para-sphenoid in the same light, and while loosely spoken of as a "splint bone" or a "membrane bone," yet it is morphologically an ossification primarily belonging to the chondro-cranium, developed in the perichondrium covering its base and afterwards incorporated into the ossifications of the cartilage.

Such an example is seen in the dentary bone of the lower jaw, found, as far as I know to the contrary, in all Mammalia; and as this is particularly germane to the subject herein considered, it will be well to mention it fully. For this purpose and in order to bring into stronger relief the elements which enter into a discussion of this subject I quote again at length from the statement of Arthur Thompson in Cunningham's Human Anatomy (p. 141) on the ossification of the human lower jaw, which is as follows:

The development of the lower jaw is intimately associated with Meckel's cartilage, the cartilaginous bar of the first visceral or mandibular arch. Meckel's cartilages, of which there are two, are connected proximally with the periotic capsule and cranial base. Their distal ends are united in the region of the symphysis. It is in the connective tissue overlying the outer surface of this cartilaginous arch that the bulk of the lower jaw is developed. The cartilage itself is not converted into bone, but undergoes resorption, except its anterior extremity, which is stated to undergo ossification to form the part of the lower jaw lying between the mental foramen and the symphysis. In a third or fourth month fetus the cartilage can be traced from the undersurface of the forepart of the tympanic ring downwards and forwards to reach the jaw, to which it is attached at the opening of the inferior dental canal; from this it may be traced forwards as a narrow strip applied to the inner surface of the mandible, which it sensibly grooves. The proximal end of this furrow remains permanently as the mylohyoid groove. The part of the cartilage between the tympanic ring and the jaw becomes converted into fibrous tissue, and persists in the adult as the internal lateral ligament of the temporo-maxillary articulation, its proximal end through the Glaserian fissure being continuous with the slender process of the malleus. The part which is applied to the inner surface of the lower jaw disappears. In the tissue overlying the cartilage, ossification begins by several centers as early as the sixth or seventh week of fetal life, in this respect resembling the clavicle, by which it is alone preceded. The dentary or basal center forms the outer wall and lower border. With this is united the splenial portion, which appears somewhat later, forming the inner table from near the symphysis backwards towards the opening of the inferior dental canal where it terminates in the lingula. By the union of these two parts a groove is formed, which ultimately becomes covered in, and in which the inferior dental nerve and vessels are lodged. As has already been stated, the part of the body between the symphysis and the mental foramen is regarded as directly developed from the fore part of the Meckelian cartilage. As will have been gathered from the above description, the upper part of the ramus and its processes have no connection with Meckel's cartilage. *The condyle and coronoid process are each developed from a separate center preceded by a cartilaginous matrix.* (Italics are mine.) These several centers are all united about the fourth month.

It may be here noted in regard to his unqualified statement to the effect that there is a separate and distinct center of ossification for each of the coronoid and condyloid processes, he is not in accord with all authorities who have written upon the subject. It is stated by others that while these cartilaginous molds or matrices are present, their actual ossification takes place by an extension of the adjacent membranous layer of the dentary, and that they then undergo absorption. The main facts in connection with the ossification of the lower jaw in man, and, in fact, in all other mammals in which the process is

known, may be thus summarized: (1) for each entire ramus there is at first a cartilaginous matrix, mold, or bar (Meckel's cartilage), continuous with the base of the skull and around which the dentary and splenial bones are developed; (2) to this main cartilage there is attached, or at least in intimate relation with it, an accessory cartilaginous mold or matrix, which gives rise to the condylar portion; (3) the anterior part of Meckel's cartilage is entirely converted into that part of the dentary lying between the mental foramen and the symphysis, which is therefore true cartilage bone; (4) the posterior portion of the dentary arises from the backward extension of the perichondrium surrounding the cartilage, but the cartilage itself does not undergo ossification but absorption; (5) the splenial is developed from the same perichrondrial membrane as the posterior portion of the dentary; and (6) the cartilaginous molds preceding the coronoid and condyloid portions either ossify from separate centers (according to Thompson) or receive their ossific deposits by means of a posterior prolongation of the perichondrial membrane from the dentary.

Now, what can we learn from these facts and what bearing do they have upon the transposition theory as a whole, and the homology of the articular with the malleus in particular? If Thompson's statement in regard to a separate center of ossification for the condyloid portion of the human jaw is correct, then the whole matter is settled and requires no further discussion; for in that event this ossification would represent the articular of the reptilian jaw beyond all reasonable doubt. But if we allow that this statement is erroneous and is not borne out by the facts, we have remaining the all-important feature or circumstance, about which there can not be the least doubt or uncertainty, that a cartilaginous mold or matrix, in intimate association with the Meckelian cartilage, is always present and precedes in the order of development the purely secondary or subordinate process of deposit of calcareous matter in this part of the cartilaginous ramus. As between the presence of this cartilaginous mold and the secondary process of its calcification, in morphological importance, there can be no question or argument whatever.

If this strict homologue or corresponding part of the reptilian or batrachian jaw has been bodily plucked out and removed to another situation, with a completely altered function in the mammal, then it is utterly inconceivable to me and entirely passes my understanding to imagine how this could have been accomplished without taking along with it the morphologically fundamental part of which it primarily consists. That this portion should have been left behind in its original and primitive position is to my mind more than significant. The burden of proof lies with those who maintain the transposition view, and if this difficulty can not be completely removed or explained, they can not only have no standing in court but the

verdict is very likely to be returned against them, and for this purpose no amount of specious or hair-splitting argument will suffice.[1]

If it is found upon further investigation that there is never any independent and separate center of ossification developed in this cartilaginous mold in any mammal (and the whole list will have to be exhausted before this can be finally determined), then it is quite as reasonable, if not more so, to conclude that it has lost its power to develop calcareous matter within its substance and that this function has been entirely usurped by the perichondrial membrane of the dentary than it is to assume that it has been entirely removed from its original position. Numerous analogous cases can be cited from mammalian morphology in which an osseous element having a cartilaginous predecessor or antecedent has been lost and its function usurped by tissue of quite a different category. Thus in the second visceral arch, the epihyal element has completely disappeared in man and some other mammals and its function has been assumed by the connective tissue (stylo-hyoid ligament) which originally surrounded the cartilaginous rod of which it always consists in the embryo. The absorption, disappearance, and replacement of this rod can no more be taken to represent transposition of this element than the absorption and disappearance of the precondyloid cartilaginous mold of the lower jaw, it matters not what may subsequently happen to it in the way of substitution or ossification. If this precondyloid mold does not represent the reptilian articular element, then we have a right to ask what does it represent and why should it be so constantly present in the jaws of all mammals?

Along this line there is considerable evidence from the embryological side which, although not entirely conclusive, is at the same time strongly suggestive. I here call especial attention to Parker's figures of the developing jaw of *Galeopterus* (fig. 8), in which a separate and distinct piece is represented for a part of the condyle, or the jaw of the mole (fig. 13) in which not only the cartilaginous mold is clearly shown but the condyle itself is represented as distinctly separated from the remainder of the cartilaginous ramus. Such conditions as are seen in the mole are found in the developing jaws of many other Insectivora, and this accords well with the possible if not probable remains of a suture in this region of the jaw of *Rhynchocyon* already described. Among the Rodentia, moreover, especially some of the Hystricoidae as well as the Cricetine Myoids, the immature jaws so frequently show the remains of a suture separating

[1] In order to meet this difficulty, Gaupp *assumes* that this accessory cartilaginous mold is a purely secondary or new structure, which has been subsequently superadded to the mammalian jaw in the course of evolution. But such an assumption without the strongest kind of proof to support it does not add anything to the weight of his contention, for if it is not a part of, nor a derivative of, the original Meckelian cartilage, and according to his view is not connected with the formation nor development of any bone, what possible use can it subserve and why should it be present at all?

the condyle from the remainder of the ramus that it does not seem possible that it is altogether accidental. These same appearances are likewise seen in the young jaws of many other orders of mammals, and until such time as it can be shown by actual embryological investigation that these appearances are wholly deceptive and that no ossification ever takes place within the cartilaginous mold of the condyle we must continue to hold that it is not only possible but highly probable in some species of mammals at least.

From my experience in the examination and study of commencing ossification of the bones in mammals I have been especially impressed with the absolute necessity of selecting embryos of the proper stages of development in order to demonstrate any given point beyond possible doubt, and this among the rarer forms is by no means always convenient or an easy matter. In attempting to follow out this subject of the presence or absence of a separate and distinct center of ossification in the cartilaginous matrix of the mandibular condyle of the mammal, I am led to conclude that if ever it is present, which is more than likely, it is at best but feebly developed and is quickly overshadowed by the ingrowth of the osteogenic membrane of the dentary, and all vestiges of it obliterated.

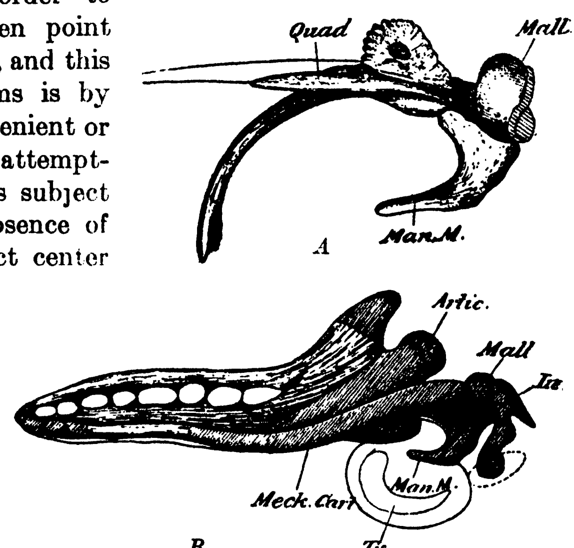

FIG. 13.—TALPA EUROPAEA. AFTER PARKER. A, ADVANCED STAGE OF DEVELOPMENT OF TALPA EUROPAEA. B, YOUNG STAGE OF DEVELOPMENT OF SAME. *Artic.*, ARTICULAR; *In.*, INCUS; *Mall.*, MALLEUS; *Man. M.*, MANUBRIUM OF MALLEUS; *Meck. Cart.*, MECKEL'S CARTILAGE; *Quad.*, QUADRATE; *Ty.*, TYMPANIC.

In view of the facts and arguments above set forth, how premature appears the sweeping statement of Gregory to the effect that embryology gives no warrant for the belief that the mammalian jaw is composed of more than a single piece, already quoted. His second postulate in regard to the so-called Triassic and Jurassic mammals, if indeed they are mammals at all, does not appeal to me as having much weight. Out of all that are known, how many of them are sufficiently preserved to show the condyle at all, and of those that are thus sufficiently perfect how many are of a suitable age to show the sutures even if they had been present in the earlier stages of

growth? One might argue with equal facility that the brain case of all bats, moles, or birds in a given osteological collection is composed of a single bone because it does not show sutures. By the same token, the basal Eocene representatives of any of the great orders of mammals lived but yesterday in comparison with the remote time when these changes were inaugurated. In a like manner, as no known Cynodont reptile can by any stretch of the imagination be considered directly ancestral to any group of mammals, no argument based upon their structure is very convincing.

Turning next to a discussion of the element or elements of the premallear tract of Meckel's cartilage mentioned in the preceding pages, I shall begin by quoting from Parker's description of the third stage of the embryo of *Choloepus hoffmanni*, in which he makes the following statement:[1]

> The main part of Meckel's cartilage has been used up—partly ossified and lost in the ramus and partly absorbed. The head of the Malleus, the osseous matter of which runs forward as the styliform "processus gracilis," has in front of it yet a large tract of the primary mandible. This thick semiosseous hook curves itself, after it becomes detached from the main bar, round the front of the tympanic cavity. The distal third is unossified; this bony tract is essentially a second "articulare internum" such as is seen in Holostean Ganoids. But this tract has a greater interest for the morphologist even than this, for such a remnant of the normal mandible is often present in adult marsupials, and for a time during the first autumn, the mole has a similar malleus, as I shall show in my next part. More than that, in a similar malleus of a young Koala (*Phascolarctos cinereus*) of the same size nearly as this young Unau, I find two small membrane bones in this premallear tract.

It seems strange to me that this highly important statement by Parker should have been so completely overlooked by subsequent investigators, since I have been unable to find any reference to it in any later work. In regard to that part of it, however, which speaks of "membrane bones" in the Koala, I have not had any suitable material of this species for study and I am unable to say, therefore, whether or not these elements of the premallear tract are "membrane bones," as he calls them. There can be no question, however, that they are preceded by a cartilaginous mold or matrix, just as much as are the incus and malleus, and whether they ossify wholly from the perichondrial membrane surrounding the cartilage, or whether a portion of the cartilage is involved in the process, they are certainly not entitled to the appellation of "membrane bones" in the same sense as this term is applied to the frontals, parietals, nasals, or other bones of this category. In the case of *Tupaia* and many other Insectivora, as well as in *Sarcophilus* and *Didelphis*, in which this element persists and undergoes ossification, the resulting bone is a solid rod or bar, and as far as I am able to judge, exactly like the stylo-hyal, epi-hyal, or cerato-hyal pieces of the hyo-mandibular arch.

[1] Morphology of the Skull, p. 65.

Now, no one would ever think of speaking of these hyo-mandibular elements as membrane bones, yet it would appear that their ossification takes place largely if not exclusively through the influence of the perichondrial membrane surrounding them. In the case of *Gymnura* and the kangaroo the ossification of the premallear element produces a solid, more or less thickened, three-cornered bony nodule, and this is to a certain extent true of this region of *Erinaceus*. In *Choloepus* again these elements are seen developing in and around the thick cartilaginous mold by which they are preceded, in a manner not at all dissimilar to that of the incus and malleus in the same stage of development, and what is here said of the Unau applies equally well to all other forms in which it is found. That the ossification of this element or these elements was originally the same and in no manner different from that of the incus and malleus, I do not think that there can be any reason to doubt, and if there are any differences at the present time they are due wholly to the fact that the latter are now functional elements still retaining their vitality and vigor, while the former are inconsiderable degenerate vestiges practically on the point of disappearance. If it can ever be shown that the cartilage itself is in the least involved in the process of ossification of these elements, in any of the species in which it exists, we can then conclude beyond any possible fear of error that it is a true cartilage bone and undoubtedly represents some missing element which originally pertained to the reptilian or batrachian suspensorium.

In all those cases wherein these elements appear in the premallear tract of the developing embryo, whether they be one or more than one, and continue into the half-grown or adult stages, it will be observed that the position is always the same, namely, to the inner side of the glenoid cavity and slightly posterior to it, passing around the inner edge of the tympanic ring, with which it often becomes intimately associated, and frequently having a free extremity projecting forwards toward the tip of the pterygoid, with which it is connected by ligament. This latter fact is highly suggestive, since it betokens a former bony connection between these elements, just as the stylo-hyoid ligament in the human subject connects the styloid process and the hyoid bone, and represents the missing bony element in the hyoid arch (the epi-hyal). Again, when we study this bone in such types as *Gymnura* and the kangaroo, we begin to realize that it has not only the exact position that would be assumed by a vestigial quadrate, but actually resembles certain parts of this bone in the reptilia. Thus we can imagine that the anterior pointed extremity represents the pterygoid process of the quadrate, the posterior extremity represents the divided posterior bar which joins the squamosal on the inner side and behind, and the blunt angular projection would be the remains of the articular head of the quadrate.

In a like manner the bone which I have described as the paramastoid may represent the vestige of that part of the quadrate which was formerly attached in this identical position.

In accordance with this conception that the vestigial element under discussion represents only a portion of the inner part of the original quadrate, we can readily understand its relations to the tympanic ring and why this latter bone should lie upon the outside of it. It will be recalled that the tympanic membrane or the eardrum is attached in the reptile largely to the outer edge of the quadrate, and when this bone began to disappear a new membrane bone was developed in the outer circumference or periphery of the membrane, namely, the tympanic ring—in order to afford the proper support for the drum. This is actually the case in some birds, notably the peafowl and others. Developing as it did in the periphery of the membrane, it would be manifestly impossible for it to be formed on the opposite side or inside of the quadrate, since its special office was the support of the eardrum, and hence as the quadrate was reduced to a vestige we find it lying upon the inner side of the tympanic. This fact supplies a powerful and convincing argument in favor of this interpretation of its homology with this part of the reptilian or batrachian quadrate. In fact I can not conceive of any other interpretation that can be placed upon it. It will thus be seen that the fate of the reptilian quadrate in the skull of the mammal was not, as supposed by Gadow, to become the tympanic, nor its transformation into the fibro-articular cartilage of the glenoid cavity as surmised by Broom, nor its absorption into the squamosal as held by Cope and Baur; but in a large number of mammals it still persists developed in the premallear tract of Meckel's cartilage, and either attached to the *processus gracilis* or incorporated with the tympanic or both.

In regard to the value of the evidence derived from the skull of *Ornithorhynchus*, already mentioned, I am not in a position at the present time, through lack of suitable material, to say whether or not the bone above described represents a distinct ossification and arises as a separate element from Meckel's cartilage in the embryo, but should such prove to be the case it will then offer powerful confirmatory evidence of the interpretation herein considered. It may be stated, however, that Watson [1] in a late paper on the Monotreme skull makes no mention of such an element, but whether his material was of a suitable stage to show it if present I have no means of knowing.

One of the insuperable objections that was urged by Gadow against this transposition theory, to the effect that it is inconceivable how the change could have taken place without seriously impairing,

[1] Trans. Philos. Soc., Ser. B, vol. 207, 1916, pp. 311-374, pls. 23-25. Not received in time for use in this connection.

if not completely destroying, the hearing, has never been met by the advocates of this view. Gregory attempts to reply to this objection in the following statement:[1]

Dr. Broom, in a letter to the writer dated July 20, 1911, wrote that he had decisive evidence showing that the doubted element is stapes and not tympanic. In Broom's figure ('11, p. 7, pl. 46, fig. 8) of the very primitive Cynodont *Bauria* this supposed stapes runs out toward the quadrate. Its distal end is imperfect, but Broom restores it in contact with the quadrate. The stapes is represented as reaching nearly or quite to the quadrate in *Cynognathus* (Broom, '04, pp. 490–498, pl. 25) and *Oudenodon* (Broom), *Dimetrodon* (Case), *Labidosaurus* (Williston), as well as in modern snakes, chameleons, tortoises, and some urodeles (Kingsbury and Reid) and caecilians (Kingsley). If, as now appears probable, the stapes touched the quadrate in Cynodonts, then it is clear that stapes, quadrate, and articular already formed a connected train of bones. Thus would be met Gadow's objection ('88) "that the incus can not be the homologue of the quadrate because of the impossibility of intercalating the quadrate as an incus into the ossicular chain as a link between the stapes (hyomandibula) and lenticulare (symplectic) and the malleus (articulare)." But the quadrate (incus) was not "intercalated" in the chain; it was there from the time that the hyomandibular (stapes) became attached to it (p. 28).

In just how far this statement constitutes an answer to Gadow's objection we shall presently see.

If we consider the subject from the broad standpoint of evolution alone, there are so many serious objections that can be raised against any such theory as to render it not only highly improbable but quite impossible. When we reflect upon the important rôle the function of hearing must always have played in the animal economy, and how necessary and vital it must have always been to those animals of a terrestrial habitat, we are then prepared to understand something of the nature of the evolution and development of this delicate and highly complex apparatus, which we have every reason to believe has taken untold generations to complete and perfect. As its highest development is now found in mammals, in which it is remarkably similar in all, we have a right to believe that the promammalian reptiles or batrachians from which they were derived had an auditory apparatus, which, while perhaps not as delicate and finely fashioned as that of the mammal, must have, according to the very nature of the case, approached it in delicacy, efficiency, and fineness of finish. There can be little doubt that it must have equaled at least in effectiveness that of birds or crocodiles living to-day, if it did not surpass them in this regard.

We may go even further than this and declare without fear of error that in all probability these promammalian reptiles, if, indeed, they were reptiles at all in the strict sense of the term, had a rudiment of an external ear; that they had a highly developed tympanic membrane stretched in front upon the quadrate, above

[1] Critique of Recent Work on the Morphology of the Vertebrate Skull, Especially in Relation to the Origin of Mammals, Journal of Morphology, vol. 24, No. 1. March, 1913.

upon the squamosal, and behind in the higher forms probably upon a delicate, commencing tympanic bone, similar to that seen in the peafowl among birds; that they had a capacious tympanic cavity, provided with eustachian tube opening into the pharynx, a fenestra ovalis and fenestra rotunda leading to the labyrinth; that across this tympanic cavity was stretched a chain consisting wholly of delicate bones or in part of cartilaginous elements, one end of which fitted into the fenestra ovalis and the other attached to the ear drum, in order to conduct the sound waves or impulses of the tympanic membrane to the lympth of the labyrinth; and, lastly, that the internal ear was provided with its proper semicircular canals, utricle, saccule, and cochlea, which may or may not have been spirally coiled.

Now, when we study the structure and function of this apparatus in its higher development, whether it be in the mammal or the higher Sauropsida, such as in the crocodile, in the birds, or even in the higher Batrachia, as in the frog, we are forced to conclude that one of the fundamental, essential, and all-important objects of its evolution has been delicacy and fineness of finish. This appears perfectly obvious, for the reason that without this delicacy of structure the finer sound waves could not be transmitted or recognized, and if its possessor were in any way dependent upon such recognition for any purpose whatever, then, in the event of its impairment, its further evolution would have been arrested and would have immediately ceased. If, on the other hand, we study the structure and function of this apparatus in its more primitive stages or less perfect manifestations, such as in the tailed Batrachia and many of the living Reptilia, we can begin to understand through what steps or stages it arose in the higher or more developed types. Thus, in all Batrachia except frogs there is no tympanic cavity and no tympanic membrane. There is no fenestra rotunda, and the internal ear is altogether primitive. In snakes and Amphisbaenoids there is no tympanic cavity nor tympanic membrane. In many Chelonia, in *Sphenodon*, and chameleons the tympanic membrane is covered with integument, etc. All of these facts, as well as many others that could be mentioned, simply go to show how the more perfected development has been brought about.

Another fact to be mentioned in this connection is that in all the lower types of structure of this hearing apparatus the quadrate is always present and strongly developed and acts as a suspensorium of the lower jaw, just as is the case with the articular, the element by means of which it is hinged or articulated with the mandible. But at the same time it must not be concluded that a delicate hearing apparatus is not consonant nor consistent with the presence and full development of these bones, for in birds a well-developed quadrate and articular are present and in their usual positions, and the

hearing ability of birds, as is well known, is scarcely inferior to that of the most highly developed mammals. We are therefore not only at liberty to assume, but we are forced to conclude that the hearing apparatus of the promammalians, whatever they were, must have already reached a comparatively high state of development and was a delicate one before they passed into the mammalian stage, with both quadrate and articular still functioning as suspensoria and not as auditory bones, else they could not have been their forerunners.

Bearing in mind, then, the delicacy of this mechanism, with its chain of bones, one end of which was fixed in the fenestra ovalis and the other in the eardrum, and whose efficiency in performing the function for which it was especially evolved through untold preceding generations, was largely dependent upon its mobility and power to respond to the most delicate impressions made upon the eardrum, what may be asked would have been the result of any interference, however slight, with the free movement of any of these elements within their respective and prescribed arcs?

If one were to ask any physician who has had the least experience in treating diseases of the ear about such an interference, he would be compelled to reply that it would invariably result in permanent deafness or complete loss of hearing. Any thickening of the mucous membrane through inflammatory processes produces serious impairment of the hearing apparatus by reason of limiting or restricting the free movement of the ear bones. Even occlusion of the eustachian tube, by means of which the equalization of the density or rarity of the air in the tympanic chamber is maintained, results in deafness. Yet we are called upon to believe that a clumsy quadrate, in its supposedly new function could have impinged with impunity upon the delicately movable stapes, without producing an impairment of the hearing which could have had no other result than the extinction of the animal.

Gregory goes even so far as to picture a second eardrum, located in advance of the old one, and attached to the articular and quadrate, which in turn acted upon the stapes, both functioning at the same time.[1] If any such device ever existed in any mammal, it is indeed strange that embryology should not give us the faintest hint or clue, nor furnish the first scintilla of evidence of its former presence. As regards Gregory's reply to Gadow's objection, the question is not what may or may not have constituted a "train of bones," morphologically or otherwise, but *how could the quadrate have been intercalated functionally in an already delicately movable chain of bones without destroying or affecting the movement of the stapes?* As a reply to this question it is a failure. Since an impossibility can not be explained otherwise than as a thing that can not be done, we must

[1] Journal of Morphology, vol. 24, 1913, p. 34, fig. 23.

continue to hold that Gadow's objection constitutes a fatal and insuperable impediment to this impossible hypothesis.

If the facts and arguments above set forth are not sufficient to completely disprove the transposition theory, there is yet another, and I shall conclude the discussion of this subject by directing attention to a body of evidence which I regard as the most important and conclusive of all. Did this evidence stand alone without the support of the facts hereinbefore mentioned, it would be amply sufficient in itself to utterly annihilate and destroy any possibility of the truth of this hypothesis. It may be stated as follows: Huxley in his treatise on the anatomy of the Amphibia, in describing the skull of *Rana esculenta* says: [1]

> The slender permanently cartilaginous hyoidean cornu passes into the cartilage of the auditory capsule on the ventral side, between the fenestra ovalis and the articular surface for the crus of the suspensorium. The fenestra ovalis lies in a cartilaginous interspace between the exoccipital and the prootic and is filled by the oval cartilaginous stapes. The anterior face of this presents a concave facet for articulation with a corresponding surface occupying the posterior half of the inner end of the *columella auris*, the anterior half of which fits into a fossa of the prootic bone. The columella itself consists of three portions, a middle elongated osseous rod, an inner swollen cartilaginous part, which articulates with the prootic and partly with the stapes, and an outer portion, which is elongated at right angles to the rest, fixed into the tympanic membrane and attached by its dorsal end to the tegmen tympani.

What more completely homologous arrangement of the several parts of this auditory apparatus, as well as the homologies of the elements themselves, with that of the mammal could possibly be asked for? The essential points of similarity are seen in (1) that the proximal end of the hyoidean arch does not join the auditory capsule through the intermediation of the stapes or the columella, as in birds and reptiles, but is joined directly to it as in the mammals; (2) that the auditory chain consists of four main elements, namely: a cartilaginous stapes, a swollen cartilaginous inner end of the columella, a bony columella itself, and a cartilaginous portion fixed into the tympanic membrane; (3) that the stapes is short and nodular (mammalian) and not long and styliform (sauropsidan); (4) the element articulating with the stapes next upon the outside also articulates by a distinct facet with the prootic on the side wall of the capsule like that of a mammal and not like that of a reptile; (5) that of the transverse cartilaginous element, upon the outside, the ventral end is fixed into the tympanic membrane, and (6) that the element lying next upon the inside forms a bony connection between the last named piece and the base of the columella.

In attempting to determine the homologies of these several elements of the auditory chain in *Rana* and those of a mammal, it is not difficult to discover that the *stapes in the two is strictly homologous beyond any shadow of a doubt*. In a like manner there can not be

[1] Encyclopedia Britannica, Ninth Edition, 1875, pp. 661, 662.

the faintest doubt or uncertainty, it seems to me, *in homologizing the succeeding element of the frog with that of the incus of the mammal.* The outstanding and all-important foundation for such a homology, rests upon the fact that it articulates not only with the stapes by a distinct facet, but it likewise articulates with the prootic, in the side wall of the otic capsule, just as the short process of the incus is, without exception, received into the *fossa incudis* in all mammals and that, moreover, in the same identical position as in the frog. This is not the case in any known reptile or bird living or extinct.

If, therefore, we are thus enabled to establish the identity or homology of these two important elements in the auditory chain of *Rana* and the mammal, what of the remaining elements? They must clearly then correspond to, and be homologous with the malleus, the cartilaginous transverse portion, the ventral end of which is fixed between the layers of the ear drum, representing the *manubrium of the malleus*, the dorsal end having probably degenerated into the superior mallear ligament; and the osseous portion representing *the head and body of the bone in the mammalian auditory apparatus.* The correctness of this determination is further established by the researches of Kingsley, who has conclusively shown that the manubrium of the malleus arises as a separate element in the auditory chain of the mammal.[1]

That the mammalian auditory chain originally arose and was developed from a chain of elements *similar in all respects* to that now found in the Anourous Batrachia, there can be therefore apparently little or no question whatever. If on the other hand the auditory chain of the Reptilia has always been characterized by the essential features now displayed by the modern Sauropsida, then in that event they can not have had anything to do with the ancestry of the Mammalia, however much they may have approached them in other respects. These features are seen in the long styliform condition of the stapes, the absence of any element corresponding to the incus, which has attachment to both stapes and the side wall of the auditory capsule, and finally, the union of the proximal end of the hyoid arch with the auditory chain, instead of the auditory capsule itself, entirely independent of any part of the former. *These differences are fundamental and profound*, and they map out most clearly and distinctly the trend of the two lines of descent.[2]

[1] The Ossicula Auditus, Tufts College Studies, vol. 1, pp. 203–274, 1900.

[2] Huxley further states in the same article that in *Menobranchus* among the Urodela, in which there is no tympanic cavity nor tympanic membrane, the stapes is relatively large and conical in form, from the conical end of which a strong ligament passes to the posterior face of the suspensorium. The hyoidean apparatus is represented, upon each side by a cartilaginous rod, subdivided into a short hypo-hyal and a long cerato-hyal. A strong ligament extends from the face of the latter, below its free summit, to the suspensorium, reaching this at the same place as the stapedial ligament, into which it is continued. This in connection with the styliform stapes of *Amphiuma* which is articulated directly to the posterior part of the suspensorium ,together with the strong hyo-suspensorial ligament and the weak hyo-mandibular ligament, seems to foreshadow the sauropsidan condition of these parts in the Urodela, quite in the same manner that the auditory chain of the Anoura foreshadows that of the mammal.

Tested by these characters, where do the extinct Cynodonts stand? Comparatively little is known of the auditory apparatus in these forms, but such information as has been recovered seems to point in the direction of the Sauropsida and not the Mammalia. This is shown by the styliform condition of the stapes, alluded to above, which is known in some of them at least, and which resembles that of *Sphenodon*. As the styliform stapes goes with the hyoid attachment, as well as the absence of any element corresponding to the incus, with its peculiar and characteristic relations to the prootic the inference would naturally be that their real affinities are with Sauropsida rather than with the mammals. If these characters are true of all of them, then they would constitute an insurmountable barrier and completely shut them out from any further consideration as ancestors of the Mammalia, it matters little what other mammalian characters they may have possessed.

There are not wanting among investigators of the present day many who loudly proclaim the Cynodonts to be the long-sought ancestors of the Mammalia, but until such time as the important matters herein discussed can be thoroughly cleared up and disposed of, we must reserve our judgment and await future discoveries. At all events as shown above, the monstrously improbable, if not altogether wholly impossible hypothesis of the intercalation of the quadrate and articular into the mammalian auditory chain, can not serve any purpose other than to befog the issue and prevent any clear understanding of the subject. It may well be that we shall yet have to go back directly to the Batrachia to find the beginnings of the Mammalia, as Huxley long since pointed out with such masterful skill. This view has been subsequently defended by Kingsley.

In the study of the foregoing subject I have consulted the following papers, other than those specifically mentioned in the footnotes of the text, namely, the numerous papers by Gaupp, the highly important contributions by Gadow, as well as those by Broom, Fuchs, and others.

Some probable causes for the disappearance of the quadrate.—Taking the quadrate of an average reptile like that of *Sphenodon* (figs. 14, 15, 16) it is to be observed that it is solidly attached to the cranium by a series of bony arches, bars, and braces, which give firm support to the articulation of the lower jaw. Above and to the inside it is attached to the lower end of the temporo-occipital arch, furnished principally by the squamosal, where it is stoutly braced from within by an outward projection of the exoccipital. Upon the outside, on a level a little above the articulation, it is braced in front by the quadratojugal bar, and above by a depending process of the squamosal. Running forwards and inwards from the articular joint is a broad stout vertical lamella of bone which unites with the pterygoid constituting

what may be regarded as the main brace of the quadrate. The braincase lies in the V-shaped interval between these two main braces of the quadrate almost adjoining it, and it is to be observed that the points of articulation of the lower jaw are widely spread apart and occupy a position nearly as far back as the tip of the occipital condyle.

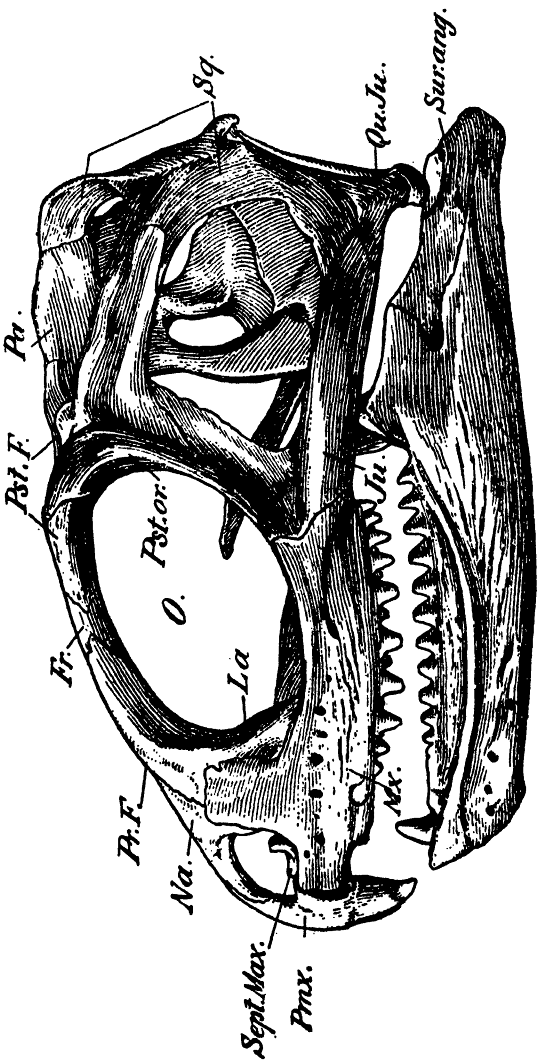

FIG. 14.—SPHENODON PUNCTATUS. *Fr.*, FRONTAL; *Ju.*, JUGAL; *La.*, LACHRYMAL; *Mx.*, MAXILLARY; *Na.*, NASAL; *O.*, ORBIT; *Pa.*, PARIETAL; *Pmx.*, PREMAXILLARY; *Pr. F.*, PREFRONTAL; *Pst. F.*, POSTFRONTAL; *Pst. or.*, POSTORBITAL; *Qu. Ju.*, QUADRATOJUGAL; *Sept. Max.*, SEPTOMAXILLARY; *Sq.*, SQUAMOSAL; *Sur. ang.*, SURANGULAR.

It is also to be noted that the articulations of the lower jaw lie upon a plain much below the base of the brain. Between the well-fixed quadrate and the side wall of the brain case there is a relatively large space which is occupied by the powerful pterygoid and temporal muscles, which close the jaws, and is in direct relation with the biting powers of the animal as well as its dental armature.

As we know so little about the immediate and direct reptilian or batrachian ancestors of the mammals, it is impossible to say just what the more precise relations of the quadrate really were originally, but in a general way they could not have been very different in arrangement and disposition to that seen in *Sphenodon*. That the quadrate was well fixed to the skull and afforded firm support to the lower jaw is a foregone conclusion, since without such an arrangement the powers of prehension and comminution on the part of the teeth could not have developed. If therefore we are to start with a more or less fixed quadrate, braced in a manner not dissimilar

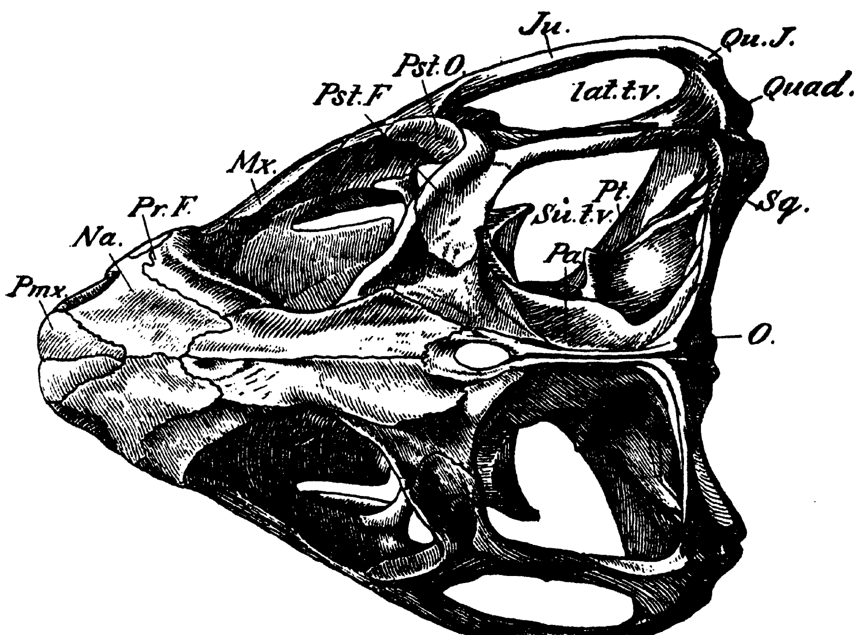

FIG. 15.—SPHENODON PUNCTATUS. *O.*, OCCIPITAL. (OTHER LETTERS AS IN FIGS. 14 AND 16.)

to that already described in *Sphenodon*, what would happen to these braces of the quadrate did the brain case commence to enlarge? Obviously the main brace running forwards and inwards to the pterygoid would be one of the first to be encroached upon and interfered with, for the reason that it lies almost in contact with the brain case. If the brain enlarged in all directions, which we have every reason to believe that it did, and allowing that the pterygoid and temporal muscles remained the same, the space which they originally occupied would be diminished, and they would in turn exercise pressure upon their enclosing arches and cause profound changes in them. This process would powerfully affect the other supports of the quadrate. That some such factors were operative, and in a large measure responsible for the changes in the quad-

rate, is strongly suggested by the modifications of the *tegmen temporalis* or temporal bony roof of the more primitive Reptilia. Certain fenestrae or vacuities were formed in this bony covering, I apprehend as a result of muscular pressure, in order to allow more space for the expanding muscles when powerfully contracted. As the brain case continued to enlarge it finally reached a point where the squamosal came in contact with it and was applied to its outer wall, receiving its support and stability from this source and no longer existing as an expanded and widely separated arch.

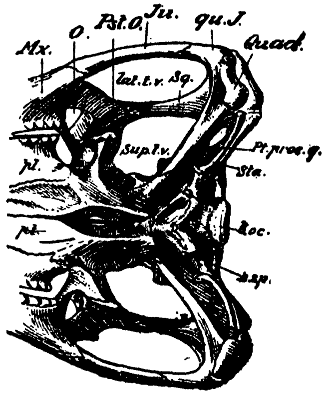

FIG. 16.—SPHENODON PUNCTATUS. *B. oc.*, BASIOCCIPITAL; *B. sp.*, BASISPHENOID; *lat. t. v.*, LATERAL TEMPORAL VACUITY; *Pl.*, PALATINE; *Pt.*, PTERYGOID; *Pt. proc. q.*, PTERYGOID PROCESS OF QUADRATE; *Quad.*, QUADRATE; *Sta.*, STAPES; *Sup. t. v.*, SUPRA TEMPORAL VACUITY. (OTHER LETTERS AS IN FIG. 14.)

Since there must at all times have existed the most intimate relations between the movements of the jaw, the dental armature and the temporal and pterygoid muscles, as well as their area and points of attachment, and as these in turn reacted upon the bony supports of the quadrate, we may safely conclude, it seems to me, that the diminution and final loss of the quadrate may be traced directly to and was the logical result of these interacting mechanical forces and factors. As the quadrate lost its bony supports and braces and was no longer capable of furnishing a proper fulcrum for the leverage of the jaw, the articulation began to shift forward upon the more fixed squamosal where the joint was finally located, the quadrate dwindling away to the inconsiderable vestige which has already been discussed. If therefore, these modifications of the quadrate, the arches, the teeth, the jaws, and, more than likely, the palate as well, are traceable to these causes which were primarily inaugurated by the enlargement of the brain, or, in other words, those very changes which transformed the reptile or batrachian into the mammal in so far at least as the skull is concerned, then the interesting question arises were these modifications confined to a single group of reptile-like forms, or is it not possible that they could have been inaugurated in widely separated groups quite independently? If the progressive enlargement of the brain has been one of the prime determining factors in the process, then it would appear probable that it was not confined to any one group of promammalian reptiles or batrachians any more than this special character is confined to any particular group of mammals today. It is a well-known and universally recognized fact in evolution that similar habitat, environment, and conditions have produced similar structures to such an extent that it is often difficult to say

in certain cases whether given resemblances represent real genetic affinities or are mere convergences. How much more likely that this should have happened where the result was dependent upon a single or a few primary factors, like the enlargement of the brain and the functional development of the teeth. Altogether I am disposed to look upon the polyphyletic origin of the Mammalia as not at all improbable.

The temporal area.—In the primitive reptilian skull the temporal area is completely covered over with a bony roof (*tegmen temporalis*), freely communicating in front with the orbital cavity and having a large opening behind on each side and above the foramen magnum, the supraoccipital vacuity. In the recent state this latter opening is largely occupied by the powerful neck muscles which are attached to the skull in this region, just as the space under the bony roof and between it and the brain case is occupied by the temporal and pterygoid muscles. Upon the outside and below the supraoccipital vacuity is a second opening piercing the quadrate from before backwards, whose boundaries may be furnished by the quadrate alone or in conjunction with quadrato-jugal. As the upper vacuity is called the supraoccipital so the lower should be termed the *lateral* occipital or quadrate vacuity.

In different orders of the Reptilia this bony roof loses its continuity and is interrupted by one or two openings called, respectively, the *supratemporal vacuity* and the *lateral temporal vacuity*, the various arrangements of which furnish some important characters for the classification of the major divisions. As a result, therefore, of the appearance of these vacuities, the *tegmen temporalis* is broken up into the various arches or arcades which furnish the boundaries of these openings. Thus we have in such a typically reptilian skull as that of *Sphenodon* (fig. 15) a temporo-occipital arch or arcade which occupies the position of the lambdoidal crest of the mammal, above and to the outside of the occipit, and separates the supraoccipital vacuity behind from the supratemporal opening in front. We likewise have a supratemporal arcade running backwards from the postorbital arch, cutting off the supratemporal vacuity from the lateral temporal opening and lastly the postorbital arch limiting the orbit behind and the quadrato-jugal arch completing the boundary of the eye cavity and the lateral temporal vacuity below.

It has been already noticed on a former page how in the transition from the reptilian or batrachian to the mammalian condition, because of the great enlargement of the brain case many of these arches and vacuities have either been obliterated or profoundly modified, most probably as a direct result of muscular pressure; and it now remains to discuss the possible or probable types of reptilian or batrachian skull from which some of the various types of mammalian skulls

could have been derived. If we compare such reptillian skulls as those of *Cynognathus*, *Procolophon*, and *Sphendon* it will be seen that they differ from each other considerably not only in the disposition of the component bones and the arrangement of the vacuities, but in the general shape and form as well. Thus *Cynognathus* has an elongated, compressed, narrow type of skull with a small orbital cavity and a large supratemporal vacuity, while *Procolophon* exhibits a short, broad, flat type of skull without supratemporal vacuity and with a large orbital cavity. The large temporal area in *Cynognathus* with its strong sagittal crest and a well-developed coronoid process of the lower jaw is in direct correlation, moreover, with the size and strength of the temporal and pterygoid muscles, as well as with the enlarged canines and the more or less molariform character of the teeth. These features are in marked contrast with the small temporal area, the reduced coronoid, and the comparatively weak development of the teeth in *Procolophon*. Then, again, in this latter genus we observe how the parietal is extended laterally and sends down a strong process behind the orbit to assist in forming the postorbital bar. If this latter condition exists in any Cynodont I have been unable to find any mention of it or refer to any figure showing it.

If now we turn to the skulls of the mammals we see that these same different types are to be met with among them. Thus all the Carnivores and carnivorous Marsupials exhibit the compressed, narrow, elongate skull, with large temporal area and prominent crests for the attachment of the temporal muscles in direct correlation with the enlarged coronoid and the powerful laniary canines. The eye cavity is relatively small and the postorbital process of the frontal has been shoved far forwards in advance of the junction of the frontal and parietal where these two bones meet above the orbit. On the other hand, taking such types as *Rhynchocyon*, *Tupaia*, *Procavia*, *Galeopterus*, and to a less extent the skulls of the Rodentia, Primates, and *Myrmecobius*, it will be observed that the cranium is relatively short and broad, the temporal area is reduced, the coronoid of the mandible is small and the parietal sends a large process downwards and forwards to form either a large part of the postorbital bar or to contribute to its make-up. This is especially true in the case of the first four of these types in which the postorbital process springs either from the point of junction between the frontal and parietal or largely from the parietal alone, while in the others the origin of the postorbital bar above is slightly in advance of the parieto-frontal suture.

If this latter type of skull arose from a reptilian condition such as is seen in *Procolophon*—and this would seem to be reasonably demanded by the facts—then this region of the skull of *Rhynchocyon* must be the most primitive of all this group, since it most resembles

the arrangement of the conditions seen in the reptile. From the structure and relations of the temporal area as exhibited in *Rhynchocyon*, to such a type as *Tupaia*, *Galeopterus*, or *Procavia*, the transition is easy and accomplished with very slight modifications. In the same way slight further modifications would produce the conditions found in the Primates, Cheiroptera, Rodents, and *Myrmecobius*, in which the point of origin above of the postorbital bar is located slightly in advance of the parieto-frontal union. If these conclusions are well founded, then it becomes a matter of considerable doubt whether the postorbital bar of the reptilian stage has ever been broken through and destroyed in such forms as *Tupaia* and the Primates, in which it is complete, but still lingers as a heritage from their reptilian ancestors. If, moreover, this type of mammalian skull is to be traced to a reptilian source of this nature, then it would appear that there must have been two or more types of reptilian skull from which the mammal was derived, since it is inconceivable that the form displayed by *Rhynchocyon* could have arisen from such a type as that shown by the carnivore or carnivorous Marsupial in which the relations of the temporal area and its surroundings are so fundamentally different.

If the Cynodonts have had anything to do with the ancestry of the Mammalia—and it is undeniable that they exhibit many decided approaches to the mammalian condition in their structure—then we must assume (1) either there existed an unknown group of them with a skull form not very different from that of *Procolophon* from which all mammals were derived, or (2) that the mammals arose from more than one type, or (3) that the mammalian resemblances of the Cynodonts are purely accidental and without any special significance as far as direct ancestry is concerned. These alternatives are suggested by the fact that the Cynodont skull as we at present know it could have given rise to the carnivorous type of skull alone, and it is unthinkable that the other type of mammalian skull as exemplified by *Rhynchocyon* could have been derived from this form. We can readily understand, on the other hand, how the compressed narrow type of skull could have arisen from the *Rhynchocyon* type, since we have the examples of *Cercoctenus* and *Petrodromus* before us, which are more or less transitional between the two and afford an explanation of how the other Insectivora may have reached their present condition. In these two genera there is no bony postorbital process above or below, but along the upper margin of the orbit and as far back as the parieto-frontal suture there is in the recent state a dense, thickened, more or less triangular fibrous pad, which is attached to a roughened area on the eye margin, which undoubtedly represents and is the remains of the postorbital process. This fibrous pad is intimately connected with the fascia covering the temporal muscle behind, the

deep fascial lining of the eye socket, and sends down a strong band to the zygomatic arch to complete the posterior boundary of the orbit. The orbital edge of the parietal, moreover, is produced and angulated, furnishing a condition very similar to that seen in *Tupaia*, with the exception that the bony parts representing the post frontal and the postorbital have been reduced to the fibrous structure already mentioned. The general shape of the skull is more compressed and elongated than in *Rhynchocyon*, but the temporal area is small, the temporal muscle is weak and the mandibular coronoid is little developed. The extreme development of these modifications is to be seen in *Centetes* among the modern Insectivora in which the skull is long, narrow, and compressed, the temporal area greatly. enlarged, with unusually high crests, and with complete absence of a postorbital process. Directly correlated with these latter characters is the loss of the zygomatic arch and the great enlargement of the mandibular coronoid. Thus the various steps may be conceived of just how the elongated and compressed type of skull could have arisen in the Insectivora at least.

Myrmecobius among the Marsupials occupies nearly the same position in this group with reference to these characters that *Rhynchocyon* does among the Insectivora, and if the Mammalia are of monophyletic origin then, in my judgment, we must look for the precursor of this type of skull in their reptilian ancestry rather than the carnivorous type. If, on the other hand, the various orders of mammals arose from more than one group of reptiles independently, which upon the whole appears to me not at all impossible or improbable, then it would be only reasonable to suppose that there were various forms of skulls developed while yet in the reptilian stage which passed into the mammal.

Mammalian interparietals.—Another matter of importance in connection with the temporal area in the mammalian skull is the presence of an extra bone often seen intercalated between the parietals and the occipital which is always referred to as the *interparietal*. Careful investigation of the development of this seemingly unpaired element reveals the fact that it is always developed from at least two centers, and there may be as many as four. I have not been able to find any ossification corresponding to an interparietal in any of the carnivorous Marsupials except the Bandicoots and *Myrmecobius*. In the former of these species there are two elongated ossicles surmounting the lambdoidal crest which without much doubt represent paired interparietals. In *Myrmecobius* these bones consist of a pair of sizable ossicles lying upon either side of the median line just in advance of the occipital crest at the junction of the occipital with the parietal. It is very commonly present in the adult skulls of the kangaroos and phalangers, and when sufficiently

young stages are examined is seen to develop from at least two centers, if not more. The apparent absence of these elements in the majority of the carnivorous Marsupials may be due either to their gradual crowding out upon the occipital crest as seen in the Bandicoots or their union with the occipital at a very early period; but it may be said that in opossum embryos of very young stages they are not evident.

According to the researches of Parker no elements corresponding to interparietals are ever found in the Edentates except *Orycteropus*. I have not found any traces of them in very young embryos of *Dasypus*, and it is doubtful whether they exist in any of the American Edentates.

Among the Cheiroptera interparietals can always be distinguished in the young stages, and they arise from at least one and probably two pairs of ossific centers. This is also true of the Rodentia, although I have seen little or no evidence of a second pair of centers in this group. In the Insectivora one pair of centers for the interparietal can always be made out in the youngest embryos, and in *Ericulus*, as figured by Parker, there are two pairs of centers for these bones. In the human skull Thompson states that there are two pairs of centers which early unite to form the squamous part of the supraoccipital; and by inference this is true of the other Primates, although I have not seen sufficient embryological evidence to establish it beyond doubt. In *Cheirogaleus* and *Microcebus* among the Lemuroids there is a large and distinct interparietal in the adult skull, but in the adult stages, at least, it is absent in the skulls of other lemurs. Among the Carnivora an interparietal is present in the dogs, cats, seals, bears, raccoons, and probably in all others of this order in the younger stages of development. An interparietal is also found in *Procavia*, in the Ungulates, and the Cetacea, and lastly a pair of large interparietals are seen in the Monotremes.

The homology of one pair of these interparietal elements with the corresponding bones in the reptilian skull is apparently not difficult to discover, and if we can judge from the position and relations as seen in many reptilian types, they must represent what are called supratemporals by many authors. It does not appear certain from the numerous figures of the skulls of the extinct Reptilia whether or not there are any of them that have, in addition to the supratemporals, a pair of prosquamosals, but if such is the case then this second pair of interparietals would be homologous with them. There can be no doubt, however, that the extinct Batrachians always show three pairs of bones in this situation; and if the supposed reptilian ancestors of the mammals have only a single pair of these elements it is not easy to understand how they could have given origin to those mammals with two pairs of these bones.

In the preparation of the foregoing paper my best thanks are due to Mr. G. S. Miller, curator of the Division of Mammals in the United States National Museum, for the free use of the material under his charge, as well as for much kindly help and advice. I am also especially indebted to Messrs. J. W. Gidley and Charles W. Gilmore, of the Division of Vertebrate Paleontology of the Museum, for much valuable help and assistance. In the course of preparation of the manuscript I have discussed with these keen students of the subject each and every point of the conclusions herein reached, and I feel that they are entitled to something more than a mere formal acknowledgment. The illustrations have been faithfully executed by that veteran illustrator, Rudolph Weber, in his usual masterful manner.

ON SOME FOREST LEPIDOPTERA WITH DESCRIPTIONS OF NEW SPECIES, LARVAE, AND PUPAE.

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The present paper deals entirely with species in the United States National Museum that have been reared in connection with the forest insect investigations of the Bureau of Entomology, either by the writer at the Eastern Station at Falls Church, Virginia, or by other workers of the Division of Forest Insects at the Pacific Slope Station at Ashland, Oregon. In each case the original collector's name and the "Hopk. U. S." number of the experiment are given. Some thirty-odd forms are treated. From these are erected 1 new genus, 16 new species, and 2 new varieties. Two older species are reduced to the rank of varieties and full larval descriptions are given of 8 species, 6 of which represent genera hitherto undescribed in their immature stages. Five similar pupal descriptions are also given.

The drawings which accompany this paper and which give it special significance were made by Miss Mary Carmody and Miss Eleanor Armstrong of the Bureau of Entomology, under the immediate supervision of the author. It will be noted that, wherever possible, the male genitalia of the type specimen of each new species has been figured. These organs, heretofore so little used in the Microlepidoptera, offer excellent characters for the separation of species, genera, and families and will have to be reckoned with in future attempts at classification in that group.

Family OLETHREUTIDAE.

EVETRIA COLFAXIANA Kearfott.

Evetria colfaxiana Kearfott, Trans. Amer. Ent. Soc., vol. 38, Jan., 1907, p. 3.
Evetria siskiyouana Kearfott, Can. Ent., Mar., 1907.
Evetria taxifoliella Busck, Proc. Ent. Soc. Wash., vol. 16, 1914, p. 146.

This species was originally described by Kearfott from a single specimen collected by Arthur Vachell at Colfax, Placer County, California. Later he described *Evetria siskiyouana* from two collected specimens, one male from Siskiyou County, California, and a male from Oregon.

In 1913 Mr. Josef Brunner of the Bureau of Entomology reared a large series of moths from larvae feeding in the cones of *Pseudotsuga taxifolia* in the neighborhood of Missoula, Montana. These were determined by Mr. Busck as a new species close to, but distinct from, *siskiyouana* Kearfott and described by him under the name *taxifoliella* Busck. Large series of the latter species were also reared by Mr. J. M. Miller from cones of *Pseudotsuga* collected in Oregon, California, and Colorado. *Siskiyouana* Kearfott was also reared in considerable numbers from cones of *Abies concolor*, *Abies shastensis*, and *Abies magnifica* collected in California, Oregon, and Colorado. The California and Oregon specimens of *siskiyouana* agree with Kearfott's type in all details. Similarly the several rearings of moths from *Pseudotsuga* cones in Montana all agree with Busck's type series of *taxifoliella*. In these two forms we have what appear to be two quite distinct species. The California and Oregon *siskiyouana* is nearly twice the size (in adult and pupa) of the Montana *taxifoliella*. The ground color of the fore wings of the latter form is a rich rust brown with only a slight sprinkling of black scales, while in *Siskiyouana* the brown scaling is much paler and limited to a smaller area near the termen and apex of the wing, the ground color is more suffused with black scales and the pale blotches and cross markings a lighter gray white and more sharply defined. In both forms the head and face scales are mixed black and white and the hind wings a smoky brown.

In Oregon and California the *Pseudotsuga* form shows considerable variation from the type. The moths are uniformly larger, about half way between the typical *taxifoliella* and *siskiyouana*. The wings are slightly narrower and the body more slender than those of *siskiyouana* from the same localities. The blotches and cross markings of the fore wings are more extended than in the Montana form and less sharply defined than in the typical *siskiyouana*. The scaling on the face is a uniform pale ochreous and the white scales are absent from the head, also there is much less brown in the ground color than in the Montana *taxifoliella*. The hind wings are smoky brown. This is the form described by Kearfott as *colfaxiana*. I have compared a large series with his type and they agree in all details.

Colorado specimens of both the *Abies* and *Pseudotsuga* moths differ strikingly from the typical forms of *siskiyouana* and *taxifoliella* and also rather markedly from the Oregon and California *colfaxiana*. The hind wings are much paler, the pale spots and cross markings on the fore wings are more extended and run together until the ground color is largely lost and the moths have a decidedly more grayish appearance. The larger moths reared from *Pseudotsuga* are the same size and have the same width of fore wing as the average from *Abies*. They differ slightly in that they have a faint dusting of yellow along the cell that is lacking in the fore wing of those reared from *Abies*. The areas near

the termen and apex are the same color in both, that is, a pale, brownish yellow. The face scalings of the *Pseudotsuga* moths are the same as those of *colfaxiana,* while those of the *Abies* specimens are almost pure white. These differences I am convinced are only superficial and due most probably to the difference in food plant. I have made a careful study of the male genitalia of all the forms from *Pseudotsuga* and *Apies* and find them strikingly alike. The cucullus of the harpes is slightly different in extreme forms of *taxifoliella, siskiyouana,* and *colfaxiana* (slightly smaller and more sharply triangonate in the first and third than in *siskiyouana*), but there is less difference between them than between any two males of the typical *siskiyouana.* I am inclined, therefore, to consider them only as local and food plant varieties of one and the same species. Inasmuch as the Colorado variety is different from those of California, Oregon, and Montana and forms such a decided connecting link between the contrasted *Abies* and *Pseudotsuga* specimens, I am proposing for it the following varietal name.

EVETRIA COLFAXIANA COLORADENSIS, new variety.

Plate 1, fig. 2.

Habitat.—Mount Manitou, [type locality] (J. H. Pollock, W. D. Edmonston, G. Hofer, and A. B. Champlain), Cheyenne Canyon, (Edmonston, Pollock, and Hofer), Williams Canyon (W. D. Edmonston), and Garden of the Gods, Colorado (G. Hofer).

Food Plants.—*Abies concolor* and *Pseudotsuga taxifolia.* Male type reared from larvae feeding in cones of *Abies concolor* (Hopk. U. S. No. 14212a) and paratypes from cones of *A. concolor* and *Pseudotsuga taxifolia* (Hopk. U. S. Nos. 12413*a*, 12562*a*, 12563*a*, 12567*a*, 12574*a*, 13283*a*).

Type.—Cat. No. 21797, U.S.N.M. Male genitalia figured.

With the addition of this new variety our amended list of *colfaxiana* varieties will read as follows:

EVETRIA COLFAXIANA COLFAXIANA Kearfott.

Larvae in cones of *Pseudotsuga* (Oregon and California).

EVETRIA COLFAXIANA SISKIYOUANA Kearfott.

Larvae in cones of *Abies* (Oregon and California).

EVETRIA COLFAXIANA COLORADENSIS, new variety.

Larvae in cones of *Pseudotsuga* and *Abies* (Colorado).

EVETRIA COLFAXIANA TAXIFOLIELLA Busck.

Larvae in cones of *Pseudotsuga* (Montana).

EVETRIA ULTERIORANA, new species.

Plate 1, fig. 1.

Labial palpi ashy grey brown, darker above. Antennae greyish brown. Face, head, and thorax brownish dusted with ashy grey.

Forewings a rich dark velvety brown with iridescent grey cross markings between which lie patches and streaks of black scaling; a straight, ill-defined, fairly broad band near base; an angular, narrower, better defined band just beyond basal third and with the apex of the angle pointed toward the termen; just beyond this a straight band from costa to dorsum slanting in the direction of tornus; beyond these on apical half of costa four short dashes of white scales fading out in iridescent grey a short distance from costa; the costal edge of the second and third fascia are also white scaled; an oval ring of iridescent grey scales on tornus; a fine black line along termen; cilia brown. Hind wings dark brown; a dull black line at base of cilia; cilia beyond silver grey. Underside of abdomen and legs brown, sprinkled and marked with silver grey. Underside of hind wings shining brownish grey; underside of forewings slightly darker. Male genitalia of type as figured; extremely close to that of the typical *taxifoliella* Busck; the triangonation of the cucullus is a trifle blunter and the socii are rounder at the tips than those of any of the *colfaxiana* varities. Alar expanse, 13-14 mm.

Habitat.—Waldo [type locality] and Ashland, Oregon. (Sergent and Keen.)

Food plant.—*Pseudotsuga taxifolia.*

Reared from cones under Hopk. U. S. Nos. 12547*a*, 12547*aa*, 13209*aa*-5.

Type.—Cat. No. 21798 U.S.N.M.

Several of these moths have been reared at the Pacific Slope Station at Ashland, Oregon of the Division of Forest Insects with different lots of *Evetria colfaxiana colfaxiana*, the moths issuing at the the same time and under the same conditions. I have hesitated a long time in naming the species for it is very possible it may be only an extreme variety of *colfaxiana*. The fact, however, that it is not geographically separable or distinguishable by food plant from the other varieties coupled with its distinctly different color scheme and general appearance forbid its being placed as a variety under *colfaxiana* unless it can be proven to be such.

EVETRIA LUCULENTANA, new species.

Plate 1, fig. 3.

Palpi, face, head, and thorax creamy white. Forewings creamy white overlaid with golden brown, with a thin sprinkling of black scales, and cross marked by several narrow, interrupted fasciae of shining steely blue; the white color predominating in the middle of the wing where it forms a broad, poorly defined fascia edged by metallic steel blue scales; on the outer half of the wing the white color is limited to four costal streaks, the first, third, and fourth very short, the second extending as a faint line nearly across the wing;

predominating color of the wing on outer half, a light golden brown; cilia black at base, paler beyond and shading again to black at extremeties. Hind wings pale, smoky brown; underside lighter with small patches of brown scales at apex and a thin interrupted line of brown scales along termen; cilia grey. Fore and mid tibiae and tarsi white, banded and dusted with blackish brown; hind legs white with a few scattered brown scales on tarsi. Abdomen greyish white. Male genitalia of type figured. Alar expanse, 16-17 mm.

Habitat.—El Paso County, Colorado, (W. D. Edmonston) [type locality] and Palmer Park, Colorado (J. H. Pollock).

Food plant.—*Pinus scopulorum.* Three moths reared under Hopk. U. S. Nos. 10764*a* and 13931*d* from larvae inhabiting pitch nodules and feeding on terminals of branches. Moths issued May 5, 8 and 25, 1916.

Type.—Cat. No. 21799, U.S.N.M.

This species is very close to *E. metallica* Busck but easily distinguished by its lighter and more brilliant coloring. The tegumen and basal half of the harpes of the male genitalia are also somewhat broader than in *metallica.*

EVETRIA ALBICAPITANA ARIZONENSIS, new variety.

Plate 1, fig. 4.

From a number of cuttings of *Pinus cembroides* from the Santa Catalina Mountains, Arizona, infested by nests of a *Tetralopha* species were also reared two specimens of a nodule-making *Evetria* which I at first thought were *E. albicapitana* Busck. A careful study of the genitalia, however, shows a rather consistent difference between the two forms in the shape of the harps. The typical *albicapitana* has the costa almost straight to the tip of the cucullus while in the Arizona specimen it is distinctly concaved (figs. 4 and 5). The Arizona specimens are also smaller than the smallest specimen we have of the true *albicapitana.* The head and face is pale rust color rather than white, and the ground color of the forewings is pale rusty brown, lacking the rich dark reddish brown tinge of the typical *albicapitana.* Otherwise the two forms are identical. While such differences are hardly sufficient in this group to justify the erection of a new species, especially as we have such scanty material from Arizona and are by no means certain as to the range of *albicapitana* (we have it so far only from Canada, Wisconsin, Montana, and Idaho), they do compel at least a varietal differentiation for the Arizona form.

Habitat.—Santa Catalina Mountains, Arizona. (G. Hofer.)

Food Plant.—*Pinus cembroides.* Two moths reared June 20 and 23, 1917, under Hopk. U. S. No. 13977 from larvae mining the branches.

Type.—Cat. No. 21800, U.S.N.M. Male genitalia of type figured.

EUCOSMA RESCISSORIANA, new species.

Plate 1, fig. 7.

Palpi cream yellow, heavily dusted with black on the outer sides; terminal joint black. Lower parts of face black dusted, the slightly projecting facial tuft and head cream yellow, the head tuft slightly tinged with light rust red on the sides. Antennae narrowly banded with black above, basal joint rust red. Thorax dark rust red on forward part, heavily dusted with silver grey scales behind. Ground color of forewings rich, dark, brick red, with a faint sprinkling of black scales; a narrow, indistinct fascia of silver grey scales near base; at the basal third a distinct, moderately broad, slightly angulate fascia of orange yellow bordered within and without by a thin line of white and silver scales; a similarly marked but narrower fascia running from apical third of costa to tornus, slightly irregular and broadening out at tornus; two short geminate costal streaks of yellow, bordered with white and silver scales between the outer fascia and apex; a similar patch on costa between the two large fasciae, and two faint white streaks on the male costal fold between the basal and submedian fasciae; on middle of termen a faint orange yellow patch margined internally with silver scales; costal fold of male narrow, appressed, reaching nearly to middle of costa; cilia smoky black with two distinct white streaks opposite the patch on termen and with a fainter, narrower white streak at tornus. Hind wings dark smoky; cilia paler with a narrow dark band at base. Male genitalia of type figured. Alar expanse, 23 mm.

Habitat.—Sprague River, Oregon. (P. D. Sergent.)

Food Plant.—*Pinus murrayana.* Moth reared (under Hopk. U. S. No. 13250*d*) from larva feeding in cones on scales and seeds. Moth issued May 30, 1914.

Type.—Cat. No. 21801, U.S.N.M.

Close to *Eucosma bobana* Kearfott, but readily distinguished from the latter by color markings and male genitalia.

EUCOSMA MONITORANA, new species.

Plate 1, fig. 6.

Palpi white, well dusted with black scales; terminal joint white, broadly banded with black. Head and face cream yellow. Thorax rust red; extremities of patagia and posterior of thorax tipped with black scales. Ground color of forewing rust red, darkest on basal fourth, which is faintly cross marked by two ill-defined streaks of black and silvery scales; a broad irregularly emarginate fascia of cream yellow and white scales from just before middle of costa to

middle of dorsum; beyond this a narrower band of similar coloration extending from outer one-third of costa to tornus, widest at costa and narrowing toward tornus; two small patches of the red ground color on costal edge of the outer fascia; a short geminate white dash on costa just before apex; cilia smoky gray with a narrow black line at base; costal fold of male narrow, long, extending to middle of wing. Hind wings smoky gray brown, almost black at apex, paler on the underside; cilia pale with a dark sub-basal line. Abdomen smoky gray above. Underside of legs and abdomen a dark pepper-and-salt sprinkling of black and white scales. Underside of forewings dull smoky brown. Male genitalia of type figured. Alar expanse 13–16 mm.

Habitat.—Danville, Pennsylvania [type locality] (A. B. Champlain). Falls Church, Virginia (C. Heinrich).

Food plant.—*Pinus*, species. Larvae bore in cones.

Type.—Cat. No. 21802, U.S.N.M.

Seven specimens were reared by the writer (under Hopk. U. S. No. 13908d) from infested pine cones collected at Danville, Pennsylvania, by Mr. A. B. Champlain, of the Bureau of Entomology. All the moths issued between May 4 and 9, 1916. There is also a single collected moth in the United States National Museum taken flying by the author on May 6, 1914, and one labeled in Mr. Pergande's handwriting "*Retinia* on *P. inops*, Va. issued May 28, 1885."

The species is close to, but easily distinguished from, *rescissoriana*, from which it differs in size and color markings, in the size of the harpes and tegumen of the male genitalia, and in the shape of the aedoeagus.

EUCOSMA TOCULLIONANA, new species.

Plate 2, fig. 8.

Palpi ocherous dusted with black scales. Head and face ocherous. Fore part of thorax yellow brown; on the caudal half of thorax and patagia the scales are smoky black tipped with white. Antennae smoky black above, gray beneath. Ground color of forewings yellow brown well dusted with black scales; pattern as in *monitorana* except that the fasciae are ocherous, narrowly bordered with gray-white and the median fascia is much narrower; costal fold of male long, moderately narrow, extending slightly over half the length of costa. Cilia smoky gray. Hind wings dark smoky brown, evenly colored; underside only slightly paler; cilia as in *monitorana*. Underside of abdomen, mid femora, hind femora, and tibiae grayish white; mid tibiae mid tarsi, and hind tarsi black ringed with grayish white. Male genitalia of type figured. Alar expanse, 13–15 mm.

Habitat.—Lyme, Connecticut (A. B. Champlain).

Food plant.—*Picea.*

Five moths reared by the writer (under Hopk. U. S. No. 13921a) from larvae boring in cones, moths issuing late in May, 1916.

Type.—Cat. No. 21803 U.S.N.M.

This species is very close to *monitorana* but is readily distinguished by the ocherous rather than yellowish white cross markings on the forewings, by the narrower median fascia, and the more uniformly dark hind wings. There are also appreciable differences in the male genitalia. In *monitorana* the cucullus of the harpes is more narrowly elongate and the shoulder of the tegumen is slightly broader than in *tocullionana*.

LASPEYRESIA PALLIDIBASALIS, new species.

Plate 2, figs. 9–10.

Palpi and face very pale ocherous. Head and thorax pale grayish drab. Forewings with the basal patch grayish drab, outwardly angulate on middle but not sharply outlined, merging gradually into the deeper lustrous brown ground color of the rest of the wing; five white geminate costal dashes, the first and longest just before middle, each divided by a central dark brown line and terminating in a patch or short line of metallic scales; the costal areas between the dashes darker brown than the rest of the wing; from middle of dorsum a conspicuous white geminate dash partially divided by a faint brown line; this angulate patch nearly meeting the first costal dash, with it forming a broken, outwardly angulated fascia just beyond the gray limits of the basal patch; ocellus a patch of whitish ocherous bordered on inner and outer sides by a vertical bar of metallic scales and containing 4 or 5 longitudinal black lines; a shading of black scales just behind the inner vertical bar of ocellus; cilia shining bronzy brown with a velvety black basal line. Hind wings dark lustrous brown; cilia paler with a dark brown subbasil line. Male genitalia of type figured. Alar expanse, 11–14 mm.

Habitat.—Kaolin Beds, Oregon (Sergent and Patterson, type locality), Colestin, Oregon (P. D. Sergent), Long's Ranch, Oregon (F. P. Keen), Cheyenne Mountain, Oregon (J. H. Pollock), and Quincy, California (F. P. Keen).

Food plant.—*Abies concolor.* Moths reared in large series from larvae feeding on seeds in cones (Hop. U. S. Nos. 12538*d*–2, 12560*c*, 13263*i*, 13290*c*, 14201*b*). Moths issued during June, August, and September.

Type.—Cat. No. 21804, U.S.N.M.

This species is very close to *bracteatana* Fernald from which it is separable by its habitat, larger size, and by differences in the male genitalia. The latter are larger and the emargination at the anal angles of the harps deeper in *pallidibasalis* than in *bracteatana.*

Family PHALONIIDAE.

COMMOPHILA INFERNALIS, new species.

Plate 2, figs. 11, 13.

Palpi projecting *no more* than *twice* the length of the head beyond it, white shading to creamy white. Antennae grayish white. Face and head white shading to creamy white. Thorax creamy white, the posterior two-thirds overlaid with dull metallic gray scales. Forewings creamy white (almost yellow) with cross markings of metallic gray edged with brown and black scales; to the naked eye these cross markings are a nearly uniform olivaceous hue; a broad outwardly angulate basal patch of the dark scaling; an irregular median fascia of the same color, broadest at the costa, and greatly constricted at the upper margin of the cell; from outer fourth a similarly colored cuneiform band extending nearly to tornus and divided on costa by a patch of creamy white; the white areas of the wing faintly lined and mottled with gray; cilia yellowish white. Under side of forewings pale, shining, grayish, faintly mottled with darker metallic gray. Hind wings shining, grayish white, mottled throughout with pale fuscous; cilia whitish fuscous. Legs white, fore and middle pair heavily dusted with grayish fuscous on the outer sides. Alar expanse: 10-15 mm. Male genitalia of type figured.

Habitat.—Hell Canyon, Manzano National Forest, New Mexico. (Heinrich.)

Food Plant.—*Sabina scopulorum* ("The Cedro").

A good series of moths reared under Hopk. U. S. No. 13967*a* from larvae feeding in the berries. Larvae collected September 14, 1916. Moths issued May to August, 1917.

Type.—Cat. No. 21805, U.S.N.M.

Very close to *macrocarpana* Walsingham. The two species have practically the same pattern and coloration, but differ in size, length of palpi, color on under side of fore wings and male genitalia. *C. infernalis* is smaller, has shorter palps and is paler on the under surface of the forewings, has a stouter aedoeagus and longer stronger spines (cornuti) on the penis than *macrocarpana*. The genitalia differences are shown in figures 12–13.

The larva is white and unmarked. Legs white, tubercles and spiracles unpigmented; body hairs white; abdominal crochets weak, pale yellowish brown, 7-8; thoracic shield only slightly more yellowish than body with an irregularly triangular fuscous shading on caudal margin on each side of the broad white median line; anal shield very pale yellow. Head pale yellow; a darker patch in ocellar region; endoskeletal ridges, antennal ring of epicranium, and mandibles brown; triangular plates of hypostoma dark smoky

fuscous; ocellar pigment defining and under each ocellus, black. Length of full grown larva, 6 mm, 1-1.2 mm. wide at middle of abdomen.

Family GELECHIIDAE.

GELECHIA PERICULELLA Busck.

Plate 3, figs. 14, 15.

Gelechia periculella Busck, Proc. Ent. Soc. Wash., vol. 11, p. 178, 1909.

Until recently this species has been represented only by the unique type in the United States National Museum collection. In 1915, however, Mr. Miller of the Pacific Slope Station at Ashland, Oregon, of the Branch of Forest insects reared several moths from larvae feeding in the cones of *Pinus ponderosa* (Hopk. U. S. No. 12534*e*-2) and *Pseudotsuga taxifolia* (Hopk. U. S. No. 13209*z*) collected at Ashland, Oregon, by Messrs, Sergent and Keen. Busck's specimen is a male, unfortunately without an abdomen, collected at Humboldt County, California, in July, and has an expanse of 22 mm. The Oregon specimens average a little smaller (15 to 18 mm.). Otherwise they agree with the type and I believe they are the same species. Mr. Busck has also examined them and verifies my determination. The genitalia of the male is shown in figures 14 and 15.

GELECHIA NATALIS, new species.

Plate 4, figs. 23, 24.

Palpi white sprinkled with grayish blue; base of second joint greyish blue; brush well developed, white, with a sprinkling of blue tipped scales; terminal joint grayish blue more or less speckled with white. Face, head, thorax, and forewings white scaled with the tips of the scales bluish, giving the entire insect a grey blue color of varying intensity in different specimens. Costa of forewings in most specimens near the base lighter than the rest of the wing; a faint streak of dark scaling on basal fourth of costa; a similar spot on outer third of costa; near base of cell before middle a faint dark streak, and two dark spots in the cell on its outer costal margin, there often fusing and forming a single short, indistinct, longitudinal streak; in most specimens a narrow, faint, white, outwardly angulate fascia from just beyond outer third of costa to tornus; on outer margin of wing at base of cilia 6 or 7 faint dark dots; cilia bluish gray, slightly paler than the wings. Hind wings pale, a trifle smoky toward apex and along the veins; cilia concolorous. Legs heavily dusted with darker scales on the outer sides, grayish white on the inner. Male genitalia of type as figured; harpes divided, weakly chitinized, costa produced into a narrow, moderately long, free arm, rest of harpe greatly reduced; aedoeagus thick and heavily chitinized, tibular at base only terminal two-thirds produced into

three long, stout prongs, the two lower ones longer than the upper one. Alar expanse: 17-20 mm.

Habitat.—Waldo Canyon, Colorado [type locality] (J. H. Pollock) Monument Park Colorado (G. G. Hedgcock), and Ashland, Oregon (P. D. Sergent).

Food Plant.—*Razoumofskya cryptopoda.*

A good series of moths reared under Hopk. U. S. Nos. 12187, 12187*d*, 12515*a*2, and 13942*q* from larvae feeding on the mistletoe on *Pinus ponderosa* and *Pseudotsuga taxifolia.* Moths issued during April, June, and August.

Type.—Cat. No. 21806, U.S.N.M.

A large slate-colored species in general appearance near *trilineella* Chambers, easily identified by its peculiar aedoeagus. In the genus *Gelechia* this organ is most elaborately developed and offers very good characters for the separation and identification of species.

The larva is sordid white with a faint indication of pink along the dorsum. Legs yellow with chitinized area of coxal lobes smoky fuscous; abdominal crochets 30–32, yellowish brown (unevenly biordinal and in a complete circle); thoracic shield pale yellow or (in some specimens) brownish yellow, narrowly bordered along caudal margin with smoky fuscous, median line straight, sharp, narrow, white; anal shield pale yellow or brownish yellow with a rather large, triangular, smoky fuscous patch at each anterior lateral angle; tubercles rather broadly chitinized, smoky fuscous; body hairs yellowish white; spiracles brown. Head yellow, pale in some specimens, somewhat darker in others; posterior margins and endoskeletal ridges brown; mandibles amber brown, their fossae almost black; ocellar pigment nearly continuous, contained well within the ring of the ocelli and easily distinguished from the white lenses. Length of full grown larvae 15 mm.; 1.5 mm. wide at mesothorax.

GELECHIA NEGUNDELLA, new species.

Plate 3, figs. 17–18.

Antennae light ochreous fuscous, dusted with blackish fuscous; basal joint covered all but the tip by the darker scaling; extremities of all joints narrowly banded with black. Palpi grayish ochreous on inner and upper surfaces; blackish fuscous beneath. Face, head, and thorax light ochreous fuscous; a few blackish fuscous scales on the sides of the face and a rather heavy dusting of similar scales on the thorax. Fore wings dull ochreous fuscous spotted with black; a small black sub-costal dot at base of wing; from basial third of costa a small black dash; below and beyond this and occupying about the middle of the cell a broad ill-defined patch of blackish scales; on middle of costa a more or less obscure shading of black scales; just before apical third of costa a black dash, and below it, extending to

dorsum, an irregular, ill-defined black line, making with the black dash on costa a broken, inwardly angulate fascia; a faint dusting of black scales near outer margin of wing; cilia pale ochreous fuscous, about same color as the head scales. Hind wings as broad as fore wings; very pale, semitransparent, whitish fuscous; cilia concolorous. Abdomen whitish ochreous, faintly marked with black above, whitish below. Legs pale grayish fuscous, heavily dusted with black; tarsi banded with black. Male genitalia of type figured. Alar expanse 12 mm.

Habitat.—Barton, North Dakota. (M. S. Sudvagen.)

Food Plant.—*Acer negundo.* Three moths reared (under Hopk. U. S. No. 9905*f*–2) from larvae tying the leaves.

Type.—Cat. No. 21807, U.S.N.M.

An inconspicuous species of the *maculimarginella* group very close to *nigrimaculella* Busck. It lacks the white markings on the fore wings of typical specimens of that species; but as these are also absent from other eastern specimens of *nigrimaculella*, the two species are not readily distinguishable in color or markings. The shape of the uncus of the male genitalia of the new species, however, is strikingly different from that of any of the varieties of Busck's species and readily separates the two. In *negundella* it is bluntly arrow-shaped, while in *nigrimaculella* it is roundly oval (figs. 16–17, pl. 3). The entire genital apparatus is also somewhat larger and stouter in the Dakota species.

The larva is pale yellowish white, entirely unmarked. Legs, abdominal crochets, thoracic shield and other chitinized parts pale; tubercles small, pale, obscure; body hairs pale. Head light lemon yellow, pigmentation of ocellar area black, continuous; mouth parts pale except mandibles which are brown along the margins and anterior region of mentum which is a dark brown. Length full grown larva: 12 to 12.5 mm.

RECURVARIA QUERCIVORELLA Chambers.

Plate 5, figs. 25–26.

Recurvaria quercivorella DYAR, List N. A. Lep. No. 5602.

A large male of this species reared from oak (Hopk. U. S. No. 13965*h*–2). Larva collected by the writer in Hell Canyon, Manzano National Forest, New Mexico, September 12, 1916. Moth issued April 24, 1917. It is a very large specimen (17 mm.) for this species and for this reason, as well as on account of the locality, I should hesitate to include it under Chambers' name were it not for the fact that it agrees perfectly in all characters of the male genitalia with the typical eastern form.

C- RECURVARIA MOREONELLA, ne

Plate 5, figs. 27, 28, 29.

Antennae grayish fuscous, banded with black above. Palpi white overlaid with black; second joint black except for a white streak along the upper inner side and a ring of white scales at extremity; terminal joint white with a broad black band near base and another near the tip. Face white, with a narrow border of black scales on either side. Head white with admixture of blackish scales. Thorax and fore wings white densely overlaid with black. On basal third of fore wing below the cell a short sinuate, longitudinal line of black scales; beneath this a small raised patch of white scales; another small black patch on outer third of dorsum; above this and extending from the end of the sub-basal black streak to middle of terminal third of wing and terminating in a short hook to dorsum a narrow irregular line of white scales; a faint shading of black scales near tornus; along apical third of costal fourth, and along termen, three black dots inwardly edged with white; cilia dark grayish fuscous. Hind wings smoky fuscous; cilia slightly paler. Legs black with tibial and tarsal extremities white, except hind tibiae which are white with large patches of blackish scales. Alar expanse: 13.5 mm. Male genitalia of type figured.

Habitat.—Cheyenne Mountain, Colorado. (G. Hofer.)

Food Plant.—*Pinus scopulorum*. A single male reared under Hopk. U. S. No. 13957b-2. Moth issued July 7, 1916. Habits of the larva not noted, probably a needle miner.

Type.—Cat. No. 21808, U.S.N.M.

Close to *Recurvaria milleri* Busck but readily distinguished by its much darker color. It differs also in characters of the male genitalia. In *milleri* the caudo-lateral projections of the tegumen are greatly reduced while in *moreonella* they are conspicuously developed. Otherwise these organs are much the same in both species.

TOSCA, new genus.

Plate 4, figs. 19–21; plate 7, fig. 35; plate 8, figs. 43–46.

Type of the genus.—*Tosca Plutonella*, new species.

Moth.—Antennae simple. Labial palpi ascending, long, slender; second joint only slightly thickened with rough scales beneath; terminal joint pointed, as long as second joint. Fore wings elongate, pointed; 11 veins, 7 and 8 out of 6, 4 and 5 united, cell somewhat constricted between 5 and 6. Hind wings narrower than fore wings, trapezoidal, apex produced, pointed, termen sinuate; 6 veins, 3 and 4 separate, 5 and 6 absent, 2 and 7 weak, cell open between 4 and 7. (pl. 4, fig. 21).

Male genitalia (pl. 4, figs. 19–20) with 8th abdominal segment developed into a hoodlike covering for the clasping organs; uncus developed, short and broadly spatulate; arms of gnathos fusing into a single strong hook; sicae symmetrical projecting backward from vinculum as far as the tip of the aedoeagus; harpes symmetrical, simple, narrow, elongate, needlelike, slightly curved; aedoeagus fairly long, tubular, tapering, somewhat curved, moderately stout.

Larva (pl. 7, fig. 35; pl. 8, figs. 43, 44, 45, 46). Subcylindrical. Legs and prolegs normal. Crochets unevenly biordinal and in a complete circle, weak on the outer side. No anal fork. Prothoracic shield moderately broad, divided. No mesothoracic or metathoracic shields. Spiracles minute, round; prothoracic and 8th abdominal spiracle somewhat larger than those on abdominal segments 1 to 7. Body setae normal; tubercles small, inconpicuous; setae *III* of 8th abdominal segment directly in front of the spiracle; *IIb* of prothorax closer to *IIa* than *IIa* is to *Ia;* puncture *z* approximate to *Ib,* below the level of *IIb.*

Head capsule flattened, subspherical, square in outline viewed from above, as wide as long; greatest width at middle of head; incision of dorsal hind margin less than one-third the width of the head; distance between dorsal extremities of hind margin nearly one-half the width of the head. Front longer than wide, reaching to incision of dorsal hind margin, pentagonal in outline; adfrontal ridges (*ADFR*) straight and parallel from lower limits of epistoma to points of juncture of tentorial arms thence converging in straight lines to incision of hind margin; points of juncture of tentorial arms at middle of adfrontal ridges; adfrontal areas of frons appreciable, broadest toward the dorsal hind margin.

Ocelli six; *I, II, V,* and *VI* arranged in a parallelogram; *III* and *IV* nearly in a straight line with *II* and *V; I* and *III* larger than the rest.

Epistoma normal.

Frontal punctures (*Fa*) close together well forward of frontal setae (*F1*); adfrontal setae (*Adf1* and *Adf2*) approximate, distance separating *Adf1* and *Adf2* less than distance from *Adf1* to *F1;* adfrontal puncture (*Adfa*) behind *Adf2.*

Epicranium with the normal number of primary setae and punctures. Anterior setae (*A1, A2, A3*) in almost a straight line with lateral seta (*L1*); *L1* approximate to *A3* anterior of the level of *P1;* anterior puncture (*Aa*) directly posterior of *A2;* posterior setae (*P1* and *P2*) situated near middle of head, on a level respectively with *Adf1* and *Adf2; P2* posterior-laterad of and closely approximate to *P1;* puncture *Pa* between *L1* and *P1* nearer the former than the latter; *Pb* midway between *P2* and adfrontal suture; *Pa, P2, Pb,* and *Adfa* lying nearly in a straight line; lateral puncture (*La*) poste-

rior of the seta (*L1*), remote, on a level with incision of dorsal hind margin. Ocellar setae well separated; *O1* equidistant from and ventrad to Ocelli *II* and *III; O2* closely approximate and directly ventrad to Ocellus *I; O3* ventrad to *O2*, remote, equidistant from *O2* and hypostomal ridge; puncture *Oa* obscure, nearly obsolete, approximate and posterior to Ocellus *VI*. Subocellar setae triangular placed; *SO2* and *SO3* closely approximate; puncture *SOa* anterior to and equidistant from *SO2* and *SO3*. Genal seta (*G1*) and puncture (*Ga*) situated on middle of the ventral surface of the epicranium, well separated; seta anterior to the puncture.

Labrum with anterior and lateral margins evenly rounded, median incision broadly triangular but shallow. Seta *M1*, *M2*, and *M3* triangularly placed; *M2* postero-laterad of *M1; M1* and *M2* on a line respectively with *La2* and *La1; M3* and *La3* on a line just behind the anterior margin of the labrum; distance separating them less than that between *La2* and *La3* or *M1* and *M3*.

Epipharyngeal shield conspicuous and sharply defined; rather large; nearly a perfect rectangle, slightly rounded posteriorly. Epipharyngeal setae closely approximate; triangularly grouped near anterior margin of epipharynx; long, pointed, moderately broad.

Maxillulae normal.

Larval habits.—Leaf-miner throughout feeding period; frass voided outside the mine.

This genus is close to and derived from *Recurvaria*. In a great many of the species now listed under the latter genus veins 5 and 6 of the hind wings are weak. In *R. elachistella* Busck they are both absent. But all have 2 and 7 of hind wing strong and the forewing wider at the end of the cell and the cell itself unconstricted between 5 and 6. *Evippe pollostella* Busck (also very probably a leaf miner) belongs in Tosca on venational characters and will probably have to be referred there although the male genitalia differ in one striking detail; in *pollostella* the harps are entirely lacking. The genus *Evippe* itself should be limited to those species having both 4 and 5 of forewings present and connate or stalked.

The new genus differs from *Recurvaria* most strikingly in the larva, the diagnostic characters of which are the close approximation of setae *P1* and *P2*, the position of puncture *Adfa* behind *Adf2* rather than between it and *Adf1*, the linear Tortricid-like arrangement of setae *A1*, *A2*, *A3*, and *L1* and the pentagonal frons reaching to the incision of the dorsal hind margin. *Nealyda*, another leaf-mining Gelechiid genus, has a similar frons and also an even more flattened head but the setal arrangement is quite different. *Tosca* differs from *Recurvaria* also in an important genitalic character. In *Recurvaria* the harps are consistently and strikingly assymmetrical as are also the postero-lateral projections (or flaps) of the tegumen whenever

they are developed. In *Tosca*, on the other hand, the genitalia are symmetrical throughout. In most other respects the organs are similar in the two genera. *Evippe* has the harps symmetrical but the general structure of the genitalia is more like that of some species of *Gelechia*. *E. prunifoliella* Chambers (the type of the genus) has the gnathos developed into a long narrow mandibulate hook (pl. 4, fig. 22) with its two elements opening like a pair of ice tongs and apparently functioning as an uncus, although the uncus proper is also present and rather well developed. The latter is similar in shape to that of *Gelechia negundella* but somewhat longer and stronger.

TOSCA PLUTONELLA, new species.

Plate 4, figs. 19–21; plate 8, fig. 46.

Palpi white; a few black scales on under side of second joint; on terminal joint two narrow black bands. Antennae white, irregularly but strongly marked with black. Face, head, thorax, and forewings white, rather densely dusted with black and blackish fuscous scales. On forewing three conspicuous sub-dorsal black dots; one on vein *Ib* at basal fourth, another on vein *Ib* beyond basal third, and the third at anal angle of the cell; on the middle of the cell and near middle of costa the black scaling is also more pronounced but does not form definite spots or other markings; cilia greyish white. Hind wings pale whitish fuscous, a trifle darker toward apex; cilia concolorous; in the male on the upper side of wing along vein *Ib* a tuft of yellow hair-like scales, closely appressed and not protruding beyond the dorsal margin of the wing. Abdomen silvery white. Legs white, heavily dusted with black; tarsi white banded with black. Male genitalia of type figured. Alar expanse, 8mm.

Habitat.—Hell Canyon, Manzano National Forest, New Mexico. (Heinrich.)

Food Plant.—*Prunus.*

Type.—Cat. No. 21809, U.S.N.M.

Two moths (male and female) reared under Hopk. U. S. No. 13968 June 4 and 13, 1917, from material collected September 16, 1916. The larvae are leaf-miners in the wild cherry for their entire feeding period. The mine is irregular and somewhat similar to that of a *Parectopa*, with several branching galleries. It begins along the midrib and sometimes develops into considerable of a blotch, but normally is more or less linear and digitate. At the end against the midrib is a hole from which the larva discharges its frass (no frass is left in the mine) and adjacent to this hole along the midrib is a fine silken web under which the larva retires when not feeding.

Larva full grown about 6 mm. long. Body yellowish white faintly tinged with pink on dorsal surface; legs pale; crochets light brown, 16–20; thoractic shield divided by a pale median longitudinal line

broadening caudally, smoky brown on dorsum, growing paler on sides until it is same color as the body of the larva; other chitinized areas not pigmented, tubercles weak, uncolored; hairs short and whitish; spiracles minute, uncolored. Head dark brown, almost black on dorsal surface; ventral side yellow; mandibles brown, black at the tips; labrum dark smoky brown, almost black; ocellar pigment continuous, black.

Family BLASTOBASIDAE.

EUBOLEPIA GARGANTUELLA, new species.

Plate 6, fig. 34.

Palpi whitish gray sprinkled with dark fuscous; under side of second joint near base almost black. Antennae gray; pecten of basal joint yellowish. Face gray sprinkled with fuscous. Head black with a few grayish scales toward sides. Thorax grayish with black shadings on the forward part. Fore wings gray faintly dusted with fuscous, giving them a pale slate colored appearance; near the extreme base of the wing behind the basal tuft an indistinct black cross band, broadest on dorsum; at the middle of the wing from just below the costa, extending diagonally to the middle of the cell, a peculiar and conspicuous, constricted, trident shaped, black marking; near the apex of the cell a black spot; in some specimens a line of 3 or 4 black dots on apical fifth of costa; 3 or 4 similar dots on termen; cilia bluish gray shading to grayish ochreous. Hind wings smoky grayish fuscous; cilia slightly paler. Abdomen grayish fuscous above; under side grayish. Legs grayish, more or less marked with black; trocanter of forelegs black-scaled at outer extremity only; fore and mid femora heavily black-scaled; fore and mid tibiae banded on the outer sides with black; hind tibia grayish with a patch of black scales at base. Male genitalia of type figured. Alar expanse, 17–25 mm.

Habitat.—Brush Corral, Arizona. (Edmonston and Hofer.)

Food plant.—*Quercus*, species. Moths reared under Hopk. U. S. No. 12182 from larvae boring in large woody cynipid galls on branches of twigs of white oak. Moths issued during latter part of April and early in May, 1915.

Type.—Cat. No. 21810, U.S.N.M.

A very striking species easily recognized by the black trident shaped marking on fore wing. It is quite different from *anomalella* Dietz—the only other species listed under this genus. The male has the antennae deeply notched above the basal joint. Fortunately, though the male genitalia of the Blastobasidae are nearly uniform in size and structure, they offer reliable characters for the ready separation of species.

The larva is sordid white with the entire dorsum of the body smoke colored; ventral and lateral sides of prothorax and intersegmental

skin between head and prothorax dark smoke color, almost black. Legs yellow; abdominal crochets brownish yellow, 52–54 (triordinal and in a complete circle); thoracic shield orange yellow, a trifle darker along the caudal, lateral, and cephalic edges; tubercles brown surrounded by small but conspicuous, smoky fuscous chitinizations; tubercle III of abdominal segments 1 to 8 surrounded by a circular white area, this in turn partially surrounded by a rather wide chitinized smoky fuscous ring, broken on its dorsal margin; body hairs sordid whitish; spiracles dark fuscous. Head red-brown, the mandibles, mandibular attachments of epicranium and endoskeletal ridges dark brown, almost black; ocellar pigment irregular, black, not defining the ocelli. Length of full grown larva 18–20 mm. long; 2–2.5 mm. wide at middle of abdomen.

HOLCOCERA CONFLUENTELLA Dietz.

Holcocera confluentella DIETZ, Trans. Amer. Ent. Soc., vol. 36, p. 36, 1910.

Two specimens of this species were reared (under Hopk. U. S. No. 12170*e*–3) by the writer from cuttings of *Pinus rigida* infested by *Evetria frustrana* and a *Recurvaria*, species. Moths issued May 14 and 15, 1915. Larvae collected at Sharon Heights, Massachusetts, (Heinrich) September 23, 1914. The specimens agree in every detail with Dietz's cotype in the United States National Museum collection.

HOLCOCERA AUGUSTI, new species.

Plate 6, fig. 33.

Palpi light yellow, thickly dusted with dark fucus on outer and under sides. Face, head, thorax, antennae, and fore wings a pale, dull, golden yellow. Antennae deeply incised above basal joint. Fore wings shading to a slightly darker yellow near apex; cilia concolorous. Hind wings and cilia a trifle darker than fore wings, shading to pale fuscous. Abdomen silvery yellow above; silvery on under side. Legs pale yellow heavily dusted with dark fuscous; the outer surfaces of fore and mid tibiae and tarsi and of hind tarsi almost completely covered with dark brown scales. Male genitalia of type figured. Alar expanse, 17–19 mm.

Habitat.—Ashland, Oregon. (P. D. Sergent and J. E. Patterson.)

Food plant.—*Pseudotsuga taxifolia.* A good series of moths reared (under Hopk. U. S. Nos. 10808*h*, 10834, 10834*b*–4, 12536*k*, 13266*e*, 14280*g*) from larvae feeding in cones infested by *Evetria colfaxiana* Kearfort. Moths issued May and August.

Type.—Cat. No. 21811, U.S.N.M.

A fine, pale golden species near *inconspicua* Walsingham, but easily distinguished because of the total absence of markings or fuscous scalings on the fore wings. Named in honor of my friend August Busck whose guidance and authority in the study of Microlepidoptera I gratefully acknowledge.

HOLCOCERA PANURGELLA, new species.

Palpi grayish white, heavily dusted with blue-black scales. Antennae silvery gray. Face, head, thorax, and fore wings white dusted with blue-black scales giving the moth a pale slate colored appearance. On fore wings a narrow blue-black half fascia extending diagonally outward from just before middle of costa to dorsal margin of cell; just beyond middle a small, very faint dorsal patch of same color; from just beyond apical third of costa and extending to tornus an inwardly angulate narrow fascia of the same color, broken slightly where it crosses the costal margin of the cell; along the termen a fine line of indistinct dark dots; cilia sordid grayish. Hind wings pale, smoky fuscous; veins slightly darker; cilia concolorous, lighter toward base of dorsum. Abdomen sordid white. Under side of fore wings dull metallic fuscous. Legs whitish, well sprinkled with blue-black scales. Alar expanse, 23 mm.

Habitat.—Santa Catalina Mountains, Arizona. (G. Hofer.)

Food plant.—*Pinus cembroides* (?)

Type.—Cat. No. 21812, U.S.N.M.

A large, easily recognized species. Described from a single female reared (under Hopk. U. S. No. 13977) from branches of *Pinus cembroides* heavily infested by a *Tetralopha*, species. The habits of the larva were not noted; but it is very probably a scavenger guest in the nests of the *Tetralopha*. Moth issued June 16, 1917.

Family COSMOPTERYGIDAE.

CHRYSOPELEIA OSTRYAEELLA Chambers.

Plate 7, fig. 36; plate 9, figs. 52, 53, 57.

Chrysopeleia ostryaeella CHAMBERS, Dyar. List N. Am. Lep., No. 6132.

The work and larval habits of this species have already been so accurately and succinctly described by Clemens[1] and Chambers[2] that it is hardly necessary for me to do more than cite the references. The larva itself, however, is so interesting structurally and forms such a perfect link in the chain of Cosmopterygid genera that it is thought advisable to give a full larval description. Dr. Edna Mosher, in her paper on the classification of Lepidopterous pupae[3] has already described and figured the pupa. Chambers in his notes on the species remarks on the difficulty of rearing any number of moths. I have had a similiar experience. Out of some two hundred-odd leaves of *Ostrya virginica*, all containing mines and larvae, I was only able to rear two moths.[4]

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[1] Tin. N. Amer., p. 27.
[2] Can. Ent., vol. 6, 1874, p. 74.
[3] Bull. Ill. State Lab. of Nat. Hist., vol. 12, article 2, Mar., 1916, p. 104, fig. 95.
[4] Material collected September 1915 at Lyme, Connecticut, by Mr. A. B. Champlain who writes that the work was common on all the ironwood in that region. Moths issued June 9th and 15th of the following year.

General characters.—Elongate, cylindrical; slender; broadest at mesothorax, tapering gradually to caudal end. Legs and prolegs normal. Crochets uniordinal, in a complete circle. No anal fork. Thoracic shield broad, divided; prespiracular shield of prothorax horizontally elongate, directly anterior to the spiracle. No meso or metathoracic shields. Spiracles small, circular; prothoracic spiracle hardly larger than those on abdomen; spiracle on 8th abdominal segment on the same level as other abdominal spiracles. Tubercles small, but easily distinguished. Body steae normal; prothorax with *IIa* below the level of *Ia* and *IIb*, equidistant from both; puncture y caudo-laterad of *Ia*, between *Ia* and *IIa; Ib*, *Ic* and *IIc* forming a nearly perfect right angle well separated from *Ia*, *IIa* and *IIb; IIc* almost twice as far from *Ic* as *Ic* is from *Ib; III*, *IV* and *V* in a nearly straight horizontal line, *IV* equidistant from *III* and *V;* meso and meta thorax with seta groups *I* and *II* closely approximate. distance from *Ib* to *IIa* equal to that between *Ia* and *Ib* and *IIa* and *IIb; III* remote from *IV* and *V; III*, *IV*, and *V* in a line; *VI* unisetose; proleg-bearing abdominal segments with *I* and *II* closely approximate, *II* slightly higher than *I*, *IV* and *V* approximate, *IV* caudad of *V*, coxal setae (*VII*) in a line; abdominal segment 8 with *II* slightly lower than *I* and *IV* dorso-caudad of *V*, *VII* unisetose; abdominal 9 with *II*, *I* and *III* in a vertical line, well separated, *I* slightly nearer to *II* than to *III*, *V* antero-dorsad of *IV*, *VI* absent, *VII* unisetose.

Head not retracted within thorax; flattened; circular in outline, viewed from above; as wide or a trifle wider than long; greatest width at middle of head; incision of dorsal hind margin slightly less than one-half the width of the head; distance between extremities of dorsal hind margin one-half the width of the head. Frons triangular, long and narrow, reaching almost to incision of dorsal hind margin; adfrontal ridges straight from lower limits of epistoma to point of juncture of tentorial arms, thence converging in curved lines to a very short (hardly appreciable) longitudinal ridge; points of juncture of tentorial arms at middle of adfrontal ridges; adfrontal areas of frons very narrow; adfrontal sutures nearly straight, extending to incision of dorsal hind margin. Projection of dorsal margin over ventral only slightly less than the diameter of the head.

Ocelli six; equally spaced from *I* to *V*; *VI* equidistant from *IV* and *V*.

Epistoma normal.

Frontal punctures close together, well forward of frontal setae (*F1*); distance from *Fa* to *F1* greater than from *F1* to *Adf1* and about equal to that between *Adf1* and *Adf2; Adf2* at beginning of longitudinal ridge.

Epicranium with the normal setae and punctures. Anterior setae (*A1*, *A2*, and *A3*) forming a very obtuse angle, almost in a straight line; *A1* and *A2* close together; *A2* and *A3* well separated; punc-

ture, *Aa* postero-laterad of *A2*. Lateral seta (*L1*) in a line with *A3* and *A2*; as far from *A3* as *A3* is from *A2*; lateral puncture (*La*) postero-dorsad of *L1* as far from *L1* as *L1* is from *A3*. Posterior setae *P1* and *P2* close together, very slightly forward of middle of head; *P1* a little forward of the level of *Adf1*, on the level of *L1*; puncture *Pb* posterior to *P2*; *Pa* on the level of and remote from *Pb*, as near to *L1* as to *Pb*. Ocellar setae and puncture arranged in a right angle triangle; *O1* ventrad and approximate to Ocellus II; *O2* postero-ventrad of Ocellus I, directly posterior to *O1*; *O3* directly ventrad of *O2*, as far from *O2* as *O2* is from *O1*; *Oa* directly between and equidistant from *O1* and *O3*. Subocellar stetae triangularly grouped; *SO1* remote from *SO2* and *SO3*; *SO2* and *SO3* close together; *SOa* approximate to *SO2*, on a line between *SO1* and *SO3*. Genal seta (*G1*) antero-ventrad of the puncture (*Ga*).

Labrum with median incision shallow and broadly *U* shaped; anterior-lateral margins evenly rounded; lateral setae in a line well within lateral margin, well separated; *La2* slightly nearer to *La1* than to *La3*; *La3* on extreme anterior margin; median setae in a line; *M2* equidistant from *M1* and *M3*; *M1* on the level of *La1*, slightly back of the level of *La3*. Epipharyngeal shield large, elongate, situated well back of mediam incision of labrum which is only weakly chitinized. Epipharyngeal setae triangularly grouped just behind anterior margin, moderately long, broad, triangular, pointed. Epipharyngeal rods clearly indicated; posterior projections slender and moderately long.

Maxillulae with prominent, elongate, flexible fleshy lobs fringed with spines; no blades.

Specific description.—Full grown larva 5 mm. long. Body white with nerve ganglia visible through the skin on ventra surface as purple spots in all segments except abdominal 8, 9, and 10; in last instar larvae, a well separated pair of similar purple spots on dorsum of meso and meta thorax and 1st abdominal segment; legs white with lateral margins of the joints narrowly lined with fuscous; around each proleg below the coxal setae (*VII* and *VIII*) a narrow, smoky brown chitinous ring; crochets 16–18, dark brown; thoracic and anal shields smoky fuscous, somewhat more yellowish in some specimens; median line of thoracic shield irregular, broadening posteriorly, white; body tubercles small, dark brown (abdominal setae *I* and *II* especially conspicuous); body hairs whitish, moderately long; spiracles pale, smoky fuscous. Head pale lemon yellow with endoskeletal ridges, mandibles, and mandibular attachments of epicranium light amber brown; a short brown dash on each side at posterior lateral angle; ocellar pigment blackish brown, distinguishing the different ocelli but nearly continuous.

THEISOA CONSTRICTELLA Zeller.

Plate 7, fig. 37; plate 9, figs. 54, 55, 56.

Theisoa constrictella ZELLER, Dyar, List N. Amer. Lep., No. 6130.

On a few elms along the river bank at Great Falls, Virginia, Fr. DeGryse and the writer found most of the foliage attacked by a small caterpillar which makes a web on the underside of the leaf between two of the branching ribs, drawing the leaf together slightly and feeding on that part of the epidermis covered by the web. It also constructs a small tube of frass within the web into which it retires when not feeding. The work is locally common at Great Falls, but I have not seen it on the elms elsewhere in the vicinity of Washington. A quantity of infested leaves were collected during September, 1915, and placed to rearing (under Hopk. U. S. No. 13937). The insects pupated during October in small, smooth cocoons attached to the fallen leaves and overwintered in that stage. During the following July (1916) several moths issued. These proved to be Zeller's species. The general structural characters of the larvae show very close relationship to *Chrysopeleia*. In larval habits the two genera are also very similar except that *Theisoa* does not mine the leaf. This, as well as its more specialized head structures, would point to *Chrysopeleia* as a later development. As nothing has been previously published on the earlier stages of the genus, a full larval description is given. Unfortunately no pupae were saved, so I can not describe that stage.

General characters.—As in *Chrysopeleia* except as follows: Crochets biordinal; prothorax with *IIa* on the level of *Ia*, anterodorsad of *IIb*, closer to *IIb* than to *Ia*, puncture y directly caudad of *Ia*, *IIc* equidistant from *Ib* and *Ic*, *IIc*, *Ic* and *Ib* forming an isosceles triangle; meso and meta thorax with setae groups *I* and *II* not closely approximate, *III*, *IV*, and *V* not in a longitudinal or transverse line on segment, rather forming an obtuse angle; proleg bearing segments of abdomen with *II* remote from and slightly lower than *I*; abdominal 9 with *II*, *I*, and *III* not in a vertical line, triangularly grouped, *I* cephalad to and nearly equidistant from *II* and *III*, *VI* present.

Head ovoid; oval in outline viewed from above; as long or slightly longer than wide; incision of dorsal hind margin less than one-fourth the width of the head; distance between extremities of dorsal hind margin a trifle less than one-half the width of the head. Frons reaching only to just beyond middle of head; adfrontal ridges sinuate, nowhere straight; longitudinal ridge nearly as long as frons. Projection of dorsal margin over ventral about half the diameter of the head. Frontal punctures and frontal setae on nearly the same level; puncture *Adfa* not distinguishable. Anter or setae of epicranium forming a slightly obtuse angle; *A1* and *A2* fairly well separated

but closer together than *A2* and *A3*; *A2* and *A3* closer together than *A3* and *L1*; puncture *Aa* directly posterior of *A2*, rather remote. Lateral seta (*L1*) in a line with *A3* and *A1*; lateral puncture (*La*) not distinguished. Posterior setae (*P1* and *P2*) well separated, at middle of head; *P1* slightly forward of beginning of longitudinal ridge, on the level of *L1*; *P2* posterolaterad of *P1*; *Pb* posterior to *P1*; *Pa* almost on a line between *P2* and *L1*, slightly nearer to *L1* than to *A3*, remote from *P2*. Puncture (*Oa*) of ocellar group anterior to *O3*, postero-ventrad and approximate to ocellus *VI*. Puncture *SOa* of subocellar group on a line between *SO1* and *SO3*, approximate to *SO3*. Genal seta (*G1*) anterior to the puncture (*Ga*).

Labrum with median incision moderately deep, broadly triangular; anterior lateral margins rather acute; setae *La1* and *La2* approximate; *La3* well separated from *La2*; median setae triangularly placed; *M2* and *M1* on a line or nearly on a line with *La1*; *M3* farther from *M2* than *M2* is from *M1*. Epipharyngeal shield a very small narrow chitinization in the notch of the median incision, but clearly indicated. Epipharyngeal setae moderately long, rather well separated. Labial palpi extremely long and slender.

Specific description.—Full grown larva 6.5–7 mm. long. Body white with a slight pinkish tinge on dorsum; legs white, tarsal claws and more heavily chitinized parts hardly darker; prolegs ummarked; crochets light brown, 26–30; thoracic and anal shields very pale yellow, almost body color; median line of thoracic shield very obscure; body tubercles brown; body hairs whitish, rather long; spiracles pale brown. Head yellow; mandibles and mandibular attachments of epicranium brownish; a very dark brown spot on each hypostomal ridge near the anterior of triangular plates of hypostoma; ocellar pigment in a round, conspicuous, purplish-fuscous spot, continuous under all the ocelli.

Family GRACILARIIDAE.

PHYLLONORYCTER FELINELLE, new species.

Plate 6, figs. 30–31.

Antennae pale golden yellow above, silvery white beneath, toward the tips smoky fuscous. Palpi and face silvery white. Head tuft pale golden yellow with a very faint indication of fuscous toward the tips of the scales. Forewings light golden yellow with a medium white basal streak evenly dark margined toward costal and more faintly dark margined on dorsal side; two dorsal and four costal streaks; the first dorsal streak placed opposite the first costal, reaches middle of wing and extends toward apex beyond the first costal; second dorsal streak rather narrow, meeting second costal at middle to form an angulated fascia at outer third of wing; third

costal streak extending nearly to tornal cilia; the dorsal and costa margins white from the beginnings of first dorsal and costal streaks to base of wing; the inner sides of these white areas, as well as those of all costal and dorsal streaks, evenly dark margined; the first costal and dorsal streaks also slightly dusted with dark scales on outer margins; a conspicuous dark dot at apex; cilia golden shading to yellowish white with a median band of dark smoky fuscous. Hindwings pale smoky white. Abdomen leaden fuscous above. Alar expanse: 7.5 mm. Male genitalia of type figured.

Habitat.—Los Gatos, California (T. E. Snyder.)

Food plant.—*Platanus racemosa.*

A good series of moths reared under Hopk. U. S. No. 15187 from tentiform mines on the under side of sycamore leaves. The larvae were collected by Mr. T. E. Snyder, of the Bureau of Entomology, form trees along the river bank. His note states that the mines are so numerous as to produce what amounts to defoliation of the trees. Larvae collected June 12, 1917. Moths issued June 23 and 25 of the same year.

Type.—Cat. No. 21813, U.S.N.M.

A very striking species, close to *olivaeformis* Braun, but easily distinguished by its yellowish head tuft, the narrower second dorsal streak, and the evenly dark margined costal and dorsal dashes.

Family TINEIDAE.

DORATA INORNATELLA Busck.

Plate 7, fig. 38; plate 10, figs. 58, 59, 65, 66; plate 12, figs. 75, 76.

Dorata inornatella Busck, Proc. Ent. Soc. Wash., vol. 6, p. 124, 1904.

Several moths of this striking and interesting species were reared (under Hopk. U. S. No. 12191) by the writer during 1915 from larvae boring in the flower stems of Sotol, collected by Mr. Morris Chrisman in Buehmen Canyon, Santa Catalina Mountains, Arizona. The larvae, in superficial appearance and general shape, resemble the Coleopterous round headed borers (Cerambycidae), but have all the characters of typical Tineids. They form long galleries in the stems of the plant and pupate in the galleries in silk-lined cells near the base of the stems. The moths reared issued from early April until late June. Inasmuch as nothing has been as yet recorded of the early stages of this genus a full description of the larva and pupa is here appended.

General characters—larva.—(pl. 7, fig. 38; pl. 10, figs. 58, 59, 65, 66). Cylindrical; stout, broadest at prothorax, tapering gradually to pointed caudal end. Legs normal. Prolegs short and stout. Crochets uniordinal in a long narrow ellipse. No anal fork. Prothoracic shield broad, divided only by a faint line. No meso or

metathoracic shields. Spiracles moderate, elongate oval; that on 8th abdominal segment slightly smaller than prothoracic spiracle, on the same level, but twice the size of those on abdominal segments 1 to 7. Body setae normal. Tubercles large but weakly chitinized. Prothorax with *IIa* above the level of *Ia;* distance from *Ia* to *IIa* equal to that between *IIa* and *IIb;* puncture x dorso-caudad of *Ia;* puncture *z* approximate to *Ib;* prespiracular shield triangular, situated close to the anterior margin of the segment and with its lower edge on a level with the top of the spiracle. Setae *III, IV* and *V* rather closely approximate and equidistant on prothorax, well separated and equidistant on meso and meta-thorax and abdominal segments; *III* above and *IV* directly caudad of the spiracle on abdominal segments 1 to 7; *I* higher than *II* on first segments of abdomen, latero-cephalad of *II* on abdominal 9; *VI* unisetose on meso and meta-thorax; *VII* unisetose on abdominal 8 and 9.

Head well retracted within prothorax; ovoid; ovate in outline viewed from above; as long or longer than broad; greatest width well forward of middle of head, just back of the level of Ocellus *I;* incision of dorsal hind margin deep and narrow at least one-half the width of head; distance between extremities of dorsal hind margin about one-third the width of the head. Frons very short, somewhat heart shaped, as broad as long; adfrontal ridges nowhere parallel, sinuate and curving to a longitudinal ridge (*LR*) as long as the frons; adfrontal sutures sinuate, extending to incision of dorsal hind margin. Projection of dorsal margin over ventral more than half the width of the head.

Ocelli six; in the normal Tineid arrangement, with *I* and *II* close together, *III* and *IV* close together and well separated from *I* and *II*, *V* approximate to *IV*, *VI* well separated from other ocelli; *I* and *VI* small and weak.

Epistoma normal.

Frontal punctures (*Fa*) close together, only slightly foreward of frontal setae (*F1*); distance from *F1* to *Adf1* about equal to distance from *Adf1* to *Adf2;* puncture *Adfa* forward, closely approximate to *Adf2; Adf2* situated a little forward of beginning of longitudinal ridge.

Epicranium with normal number of setae and punctures. Anterior setae (*A1, A2, A3*) forming a right angle; puncture *Aa* lying between *A1* and *A2; A2* and *A3* on a level with *Adf1;* lateral seta (*L1*) approximate to anterior group, on the level of *P1;* distances between *A2* and *A3* and between *A3* and *L1* equal. Posterior setae (*P1* and *P2*) close togther, forward of middle of head; *P2* postero-laterad of *P1;* posterior punctures well separated; *Pa* laterad of and remote from *P2; Pb* postero-dorsad of *P2,* closely approximate to first ultraposterior seta

Lateral puncture (*La*) posterior and slightly dorsad of *L1*, remote. Ocellar setae well separated; *O1* equidistant from and slightly dorsad of Ocelli *II* and *III; O2* directly ventrad and approximate to Ocellus *I; O3* on a line with Ocelli *V* and *VI* ventrad to and remote from *O2;* ocellar puncture (*Oa*) approximate to and dorsad of *O3*. Subocellar setae triangularly grouped and equidistant from each other; subocellar puncture (*SOa*) equidistant from setae *SO1*, *SO2*, and *SO3*. Genal seta and puncture approximate to ventral hind margin of epicranium, midway between hypostomal ridge and lateral margin; puncture dorsad of the seta.

Labrum anteriorly narrowed, with entire anterior margin very slightly concaved, nearly straight. Setae of median group in the usual Micro arrangement with *M2* postero-laterad of *M1* and with *M3* forward and rather well separated from *M1* and *M2;* lateral setae (*La1*, *La2*, *La3*) on a line within the lateral margin; *La2* approximately equidistant from *La1* and *La3; M3* and *La3* on a level, well behind anterior margin of the labrum.

Epipharyngeal shield very small and poorly defined. Epipharyngeal setae triangularly grouped near anterior-lateral margin of epipharynx; narrow; pointed; moderately long. Epipharyngeal rods well developed; posterior projections long and stout.

Maxillulae normal; with well developed, strongly spined lobes.

Pupa.—(pl. 12, figs. 75, 76.) Elongate; slender; maxilliary palpi present; mandibles, labrum, fronto-clypeal suture and invaginations for anterior arms of tentorium clearly indicated; front extended upward into a point; maxillae short, slender; wings extended to mid venter of 5th abdominal segment; antennae not extending to end of wings; metathoracic legs extending well beyond end of wings; dorsum of abdomen with a row of stout spines on the cephalic margin of segments 2 to 9 and a row of smaller spines on caudal margin of segments 2 to 7 [1]; cremaster absent; tenth abdominal segment with a prominent hooked lateral projection on each side; genital opening slit-like in both sexes; anal opening long, slit-like, at extreme caudal end of body.

Specific description—Larva.—Full grown 16–17 mm. long; 5.5 mm. broad at prothorax. Body whitish, unmarked; legs brownish yellow on outer side with darker brown claws; crochets of prolegs brown, 38 to 40; thoracic shield pale yellow on anterior dorsal half, divided by a narrow white median line, posterior and lateral parts concolorous with body of larva; anal shield faintly tinged with pale lemon yellow; body tubercles moderately large, unpigmented,

[1] Dr. Edna Mosher (A Classification of the Lepidoptera Based on Characters of the Pupa, Bull. Ill. State Lab., vol. 12, art. 2, Mar., 1916, pp. 44–45) gives the absence of such caudal spines as diagnostic character for her super-family *Tineoidea*. Their presence in *Dorata* shows that their presence or absence can only be of generic significance. *Phycis* (*Scardia*) also has them well developed on abdominal segments 3 to 6 inclusive.

somewhat paler than the body color; hairs short, whitish; spiracles moderate, rather conspicuous, yellow edged with brown. Head dark brown on frons, and on antero-dorsal, lateral and ventral surfaces of epicranium; postero-dorsal region of epicranium light yellow shading to white; mandibles, hypostomal ridges and mandibular attachments of epicranium black; labrum and other chitinized parts of trophi yellowish brown; ocelli unpigmented.

Pupa.—Light brown, darker on caudal and cephalic ends; dorsal abdominal spines and projections of tenth abdominal segment blackish brown; cephalic row of spines on adbominal segment 2 weak and broken in middle for one-third of the length of the row; caudal row on seventh abdominal segment weak; male 16 mm., female 28 mm. long.

Family AEGERIIDAE.

PODOSESIA COMES, new species.

Male.—Antennae black above, chestnut brown on inner sides and between the joints on upper side near base, rather densely scaled with yellow on outer sides; basal joint whitish yellow. Palpi black, dusted with yellowish white scales above and with a scattering of white scales in tuft of second joint; third joint rather heavily dusted with yellowish white. Head black. Collar yellow above, black and white along the sides. Thorax black with a splash of bright yellow on each side beneath; a yellow scale or two on tips of patagiae and a yellow triangular patch on each side on dorsum of metathorax. Forewings transparent, bordered along costa and dorsum with black interspersed with a few orange scales; cross vein of cell orange scaled; other veins black scaled with a faint sprinkling of orange; a few orange and black scales between the veins near apex; under side of forewings similar to upper except orange dusting slightly heavier and costa yellow scaled, especially toward base; cilia black. Hind wings transparent; veins black scaled; costa dusted with orange especially on under surface; cilia blackish. Abdomen black; on segments 2, 3, 5, 6 and 7 a narrow yellow band on caudal margin of the segments, disappearing on ventre of abdomen; on 4th abdominal a wider yellow caudal band completely circling the body; lateral tufts of 8th abdominal segment black and yellow. Legs blue black; anterior coxae laterally bordered with yellow; inner sides of tibiae and tarsi patched and dusted with white and yellowish white scales; the long hair-like scales in front of anterior pair of spurs on hind tibiae, white. Alar expanse 16 mm.

Female.—Like the male except: only four yellow bands on abdomen; tuft heavier, entirely yellow above and black laterally. Alar expanse. 19 mm.

Habitat.—Brush Corral, Arizona. (Edmonston and Hofer.)

Food Plant.—*Quercus,* species. Two moths (male and female) reared under Hopk. U. S. No. 12182*a*, from the woody Cynipid galls

on white oak so heavily infested with larvae of *Eubolepia gargantuella*, described elsewhere in this paper. Moths issued May 11 (1915).

Type.—Cat. No. 21814, U.S.N.M.

An easily recognized species. The legs seem a trifle short for a *Podosesia* and are not so roughly scaled as those of *syringae* or *fraxini* but it has the characteristic palpi and belongs quite unmistakably to that genus. There is also a queer freak in venation in the male; 3 and 4 of the hind wing are distinctly separate. In the female they are stalked. The forewing of the male also has 7 and 8 somewhat shorter stalked than the female. Whether these differences are constant between the sexes I can not say as only two specimens were reared.

The larva is white with anal and thoracic shields nearly the body color, only slightly more yellow; a narrow transverse, irregular, and indistinct light brown line on each side of middle of dorsum on thoracic shield; legs yellow with brownish tarsal claws; crotchets brown, 13–16; spiracles light brown, conspicuous; tubercles unpigmented. Head brown, very pale yellow in the posterior regions of the epicranium adjacent to the longitudinal ridge; mandibles, mandibular attachments of epicranium and endoskeletal ridges black; frons thickened into a raised knob above the surface level of the epicranium, dark brown; ocellar pigment black in small individual spots under or nearly under the several ocelli. Length, full grown, 12-13 mm.

The larva is easily recognized by the peculiar elevated frons.

(SESIA) SYNANTHEDON DECIPIENS Henry Edwards.

(*Sesia*) *Synanthedon decipiens* HENRY EDWARDS, Dyar, List N. Am. Lep., No. 4228.

During 1915 a half dozen specimens of this species were reared by Mr. W. Middleton and the writer from material collected at Manitou and North Cheyenne Canyon, Colorado.

Up to this time the species had not been represented in the United States National Museum Collection and as far as I know the food plant and larval habits were unpublished. The larvae are inqueline borers in the woody galls of a Cynipid on scrub white oak, in habit and general appearance very similar to those of *S. scitula* Harris. Larvae collected during September 1914 by A. B. Champlain (Hopk. U. .S No. 12082*m*), and April, 1915, by B. T. Harvey (Hopk. U. S. No. 12153*c*). Moths issued May, June, and July.

Family COSSIDAE.

GIVIRA LOTTA Barnes and McDunnough.

Plate 7, fig. 40; plate 10, figs. 60–64; plate 12, figs. 77–79.

Givira lotta BARNES and McDUNNOUGH, Ent. News., vol. 21, p. 464, 1910.

Two adults of this species were reared by the writer during July, 1915 (under Hopk. U. S. Nos. 12425*a* and 13907) from larvae col-

lected by Messrs. George Hofer and B. T. Harvey of the Bureau of Entomology at Garden of the Gods and Manitou, Colorado. The larvae mine the rough outer bark of the yellow pine (*Pinus scopulorum*) and are evidently very common. According to Mr. Hofer's and Mr. Harvey's notes the attack is confined to the living bark of the main trunk of the tree near its base and no higher up than six feet from the ground. Pupation takes place within the mine and covers a period of slightly more than a month. The larvae in general appearance closely resemble those of the Aegeriidae, and on superficial examination might easily be so mistaken. The head characters, however, are all distinctively Cossid, while the pupa is remarkably similar in structure and appearance to that of *Zeuzera* and *Cossula*. As far as I know nothing has hitherto been recorded on the early stages of this genus. A full description of larva and pupa is therefore given.

General characters—larva.—(pl. 7, fig. 40; pl. 10, figs. 60–64). Round; stout, thickest at middle of body; 9th and 10th abdominal segments sharply tapering; caudal end narrowly rounded. Crochets evenly uniordinal, in a narrow ellipse, broken slightly at the inner extremity, weak at the outer extremity. No anal fork. Prothoracic shield small and weak, not divided. Spiracles small, round; 8th abdominal spiracle no larger, and prothoracic spiracle only slightly larger than those on abdominal segments 1 to 7. Body setae normal; tubercles weak; prothorax with *IIa* well above the level of *Ia*, foreward of *IIb*, puncture *y* directly caudad of *Ia*, on the level of *IIb*, *Ic*, and *IIc* closely approximate, *IIc* caudad of *Ic*, *III*, *IV* and *V* triangularly grouped, equidistant and closely approximate; meso and metathorax with *III*, *IV* and *V* well separated, *VI* unisetose; abdominal segments 1 to 7 with *II* much lower than *I*, *IV* and *V* closely approximate under the spiracle; *II* also lower than *I* on abdominal 8; *I* of 9th abdominal lower than *II*, equidistant from *II* and *III*, *IV* and *V* rather well separated, *VI* remote from *IV*, *VII* unisetose on abdominal segments 8 and 9.

Head considerably retracted within prothorax; small; ovoid, nearly spherical; nearly square in outline viewed from above, slightly constricted posteriorly; about as broad as long; incision of dorsal hind margin over one-fourth the width of the head; extremities of dorsal hind margins bluntly rounded, almost straight, distance between them about equal to incision of hind margin. Frons triangular, reaching to middle of head; adfrontal ridges converging in nearly straight lines to a longitudinal ridge (*LR*) about half as long as the frons; adfrontal areas of frons (*ADF*) rather broad; adfrontal sutures (*ADFS*) evenly curved reaching to incision of dorsal hind margin. Projection of dorsal margin over ventral, half the diameter of the head. Ocelli six, in normal Cossid arrangement with *V* and *VI*

well separated from the rest; *II* and *III* closely approximate; *IV* separated from *III*, but closer to *III* than to *V*; *I* well separated from *II*.

Epistoma with seta *E1* on a chitinous projection beyond its anterior margin, otherwise normal.

Frontal punctures posterior to frontal seta (*F1*); distance separating punctures equal to distance from *Fa* to *F1*; distance between adfrontal setae less than that between *Adf1* and *Fa*; *Adf2* anterior to beginning of longitudinal ridge; puncture (*Adfa*) approximate to *Adf2*, close to adfrontal ridge (*ADFR*).

Anterior and lateral and posterior setae of epicranium crowded forward on the head; *A1*, *A2*, and *A3* in a slightly obtuse angle; *A1* and *A2* close together; anterior puncture *Aa* not discernible. Lateral seta (*L1*) closely approximate to *A3* on the level of *Fa*; lateral puncture (*La*) posterior of *L1*, quite remote, nearly on a level with incision of dorsal hind margin. Posterior setae and punctures forward of the middle of the head; *P1* nearly on the level of *Adf1*; *Pb* laterad of *P1*; *P2* laterad and only slightly posterior of the level of *P1*; *Pa* approximate to *L1*, on the level of *Adf1*. *O1* of ocellar group between ocelli *III* and *IV*; *O2* posterior and approximate to ocellus *IV*; *O3* ventrad to *O2*, below the level of Ocelli *V* and *VI*; puncture *Oa* between *O2* and *O3*, approximate to the former. Subocellar group triangulary placed; puncture *SOa* closely approximate to *SO2*.

Genal seta (*G1*) antero-ventrad of the puncture (*Ga*).

Labrum with anterior margin straight; no appreciable median incision; lateral margins only slightly curved, converging anteriorly; *La1*, *La2*, *La3* in a line on lateral edge, well forward, equidistant; median setae triangularly placed nearly equidistant; *M2* posterolaterad of *M1*, slightly forward of the level of *La1*; *M1* on the level of *La2*, *M3*, very slightly back of the level of *La3*. Epipharyngeal shield not clearly indicated. Epipharyngeal setae triangularly grouped near anterior lateral angle of epipharynx; closely approximate and equidistant; slender; pointed; moderate. Epipharyngeal rods with long, stout, sharply curved posterior projections.

Maxillulae with strongly spined lobes and single row of short, rounded blades (fig. 64) similar to those in the Sesiidae.[1]

Pupa.—(pl. 12, figs. 77, 78, 79.) Elongate; moderate; maxillae triangular, nearly as broad as long, without lateral projections adhering to them on dehiscence; maxillary palpi present[2]; antennae

[1] See DeGryse: Some Modifications in the Hypopharynx of Lepidopterons Larvae, Proc. Ent. Soc. Wash., vol. 17, No. 4, 1915, p. 176, Fig. 6.

[2] Miss Mosher (Bull. Ill. State Lab., vol. 12, art. 2, pp. 30, 38, 41) gives among other characters for her *Cossoidea*, the absence of maxillary palpi. There are, however, in *Givira* and *Cossula* which resembles it in most pupal characters, small triangular areas along the cephalic margins of the prothoracic legs and directly caudad of the eye pieces which it is difficult to interpret as anything else, particularly as they separate completely from the maxillae on dehiscence. Like many another character, the presence or absence of maxillary palpi in the pupa is probably of no more than generic significance.

with slight lateral projections on the segments[1] not extending beyond middle of wings; wings short, hardly extending beyond 3rd abdominal segment; glazed and sculptured eyes indicated; mandibles conspicuous, roughly produced; labial palpi well developed with a paired thorny projection from middle; labrum small; clypeus scooped, with two pair of setae, strong lateral ridges, and a strong, spoutlike projection at base; front with a prominent cephalad projection; two cuplike protuberances on cephalic margin of genae approximate to lateral margins of front; coxae of pro, meso, and metathoracic legs clearly indicated; pro and mesothoracic legs not extending to end of wings; metathoracic legs extending a trifle beyond end of wings; mesothorax more than twice as long as prothorax; a strong median dorsal ridge on front, pro, and mesothorax; abdomen with segments 3 to 6 free (female) and with double row of dorsal spines on segments 3 to 6 and a single row along cephalic margin on segments 7, 8, 9 (female); genital opening single and slitlike; anal opening at extreme caudal end of body, slitlike; no caudal setae; cremaster absent; a pair of stout thornlike spines at caudo-lateral extremities of abdomen on each side of anal opening; spiracles round, produced, moderate.

Specific description—Larva.—Full grown about 30 mm. long; 6 to 7 mm. wide at middle of abdomen. Body china white, unmarked; legs white with black or blackish brown tarsal claws; crochets of prolegs pale brown, weak, 38–42; thoracic shield pale yellow, weakly pigmented and thinly chitinized; anal shield unpigmented; body tubercles small, unpigmented, weak; hairs short, whitish yellow; spiracles moderate, round, brown. Head pale yellow; a small brown spot at lateral angles of hind margin; antennal ring and anterior margins of epicranium and mandibles dark brown shading to black; more heavily chitinized parts of labium and maxillae pale brown; head setae whitish yellow; ocellar pigment black, not continuous.

Pupa.—Pale smoky brown; dorsal abdominal spines, chitinous projections of head and caudal extremity dark brown to black; cephalic rows of spines on dorsum of abdominal segments twice the size and approximately half the number of those in caudal rows; prothorax roughly rugose on dorsum; mesothorax smooth; labial palpi reaching to extremities of maxillae; coxae of prothoracic legs smaller than mesothoracic coxae; mesothoracic coxae extending half the length of prothoracic legs; prothoracic legs but very little shorter than mesothoracic legs; mesothoracic legs somewhat over three-fourths as long as wings; average length (female) 18 mm.

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[1] Evidently the "pectinate antennae" of Mosher.

Family PYRALIDAE.

Subfamily PHYCITINAE.

DASYPYGA ALTERNOSQUAMELLA Ragonot.

Plate 7, fig. 41; plate 11, figs. 67, 68, 71, 74; plate 13, figs. 80, 81.

Dasypyga alternosquamella RAGANOT, Dyar, List N. Amer. Lep., No. 4721.

This species is an important enemy of the mistletoe (*Razoumofskya cryptopoda*) on pine and spruce in Oregon and Colorado. Several moths were reared from larvae collected from May until late in September at Williams Canyon, Monument, and Larkspur, Colorado, and Ashland, Oregon (Hopk. U. S. Nos. 12420*m*, 12415, 13942*q*–2, and 12515*a*). According to Mr. Miller's notes the larvae feed singly and externally, and while usually very abundant are easily overlooked on account of their protective coloration. The color of the individual larvae varies in harmony with the color of the individual batches of mistletoe on which they feed. There appeaars to be one generation a year, the species overwintering as pupa in the ground. Moths reared at the Falls Church, Virginia, station issued all through May and in early June. It is probable that in nature the feeding period is comparatively short (about a month) and that the various broods issue continuously throughout the summer, since the larvae of one lot collected by Mr. P. D. Sergent at Ashland, Oregon, May 27, 1914, had all pupated by June 6th of the same year, while from the Colorado points mentioned above, larvae in various stages of development were received as late as September 23. None of the larvae received at the Eastern Station fed long after being received and from none of the lots were adults reared until the year following.

D. alternosquamella is commonly associated with *Gelechia natalis* described elsewhere in this paper, the larvae of both being equally numerous on the mistletoe. The absence of seta *III* on the prothorax as well as the enlarged and curiously chitinized *IIa* of the mesothorax and *III* on the 8th abdominal segment of *alternosquamella* readily distinguishes it from the Gelechiid. As nothing has been previously recorded of its immature stages and as it is the type and sole species of the genus *Dasypyga* a full description of its larva and pupa is appended.

General characters—Larva.—(pl. 7, fig. 41; pl. 11, figs. 67, 68, 71, 74). Cylindrical; slender. Legs and prolegs normal. Crochets evenly biordinal and in a complete circle, the outer series of hooks very short, less than one-fourth the longer series. No anal fork. Prothoracic shield moderately broad, not extending to anterior margin of the segment, divided by a rather broad, median, longitudinal line. Spiracles moderately large, circular in outline; those on prothorax and 8th abdominal segment twice the size of those on abdominal segments

1 to 7. Body setae normal; tubercles moderate; *IIb* of meso-thorax and *III* of 8th abdominal segment surrounded by a heavy, conspicuous chitinized ring; prothorax with *IIa* on the level of or a trifle higher than *Ia*, *IIb* twice as far caudad as *IIa* and farther from *IIa* than *IIa* is from *Ia*; *Ia*, puncture *z*, *Ib* and *Ic* in a line along the anterior margin of the shield, puncture *x* absent, *y* directly caudad of *Ia*, *z* dorsad and approximate to *Ib*, slightly below the level of *IIb*, *IIc* farther from *Ib* or *Ic* than they are from each other, prespiracular shield directly anterior and close to the spiracle, bearing only two setae, *III* absent, *V* approximate and ventro-caudad of *IV*; meso and metathorax with *VI* unisetose; proleg bearing abdominal segments with *II* on a level with or only slightly lower than *I*, *III* directly over the spiracle, *IV* and *V* closely approximate, *IV* caudad to and very little lower than *V*, setae *VII* triangularly grouped, equidistant; abdominal 8 with *III*, *VI* and the spiracle in a vertical line, *VII* bisetose, *II* slightly higher than *I*; abdominal segment 9 with *I* somewhat nearer to *III* than to *II*; *IV*, *V* and *VI* closely approximate and triangularly grouped, *VII* bisetose.

Head spherical; nearly square in outline viewed from above, as wide or a trifle wider than long; greatest width at middle of head; incision of dorsal hind margin about one-fifth the width of the head; distance between extremities of dorsal hind margin a little over one-third the width of the head. Frons pentagonal, reaching nearly to middle of head, a trifle longer than wide; adfrontal ridges (*ADFR*) parallel from lower limits of epistoma to point of juncture of tentorial arms, thence converging in slightly curved lines to the longitudinal ridge (*LR*) which is as long as frons; adfrontal sutures (*ADFS*) straight, meeting longitudinal ridge half way between end of frons and incision of dorsal hind margin. Projection of dorsal margin over ventral about half the diameter of the head.

Ocelli six with *III*, *IV* and *V* in a straight line; *III* and *IV* approximate; *V* and *VI* approximate.

Epistoma normal.

Frontal punctures (*Fa*) close together, anterior to frontal setae (*F1*); distance between punctures less than distance from puncture (*Fa*) to setae (*F1*); distance from seta *F1* to seta *Adf1* nearly equal to distance from *Adf1* to *Adf2*; *Adf2* a little behind the beginning of longitudinal ridge; puncture *Adfa* approximate to *Adf2*, between *Adf1* and *Adf2*.

Epicranium with the normal setae and punctures. Anterior setae (*A1*, *A2*, *A3*) in a very slightly obtuse angle; *A2* and *A3* well separated; puncture (*Aa*) posterior to *A2*. Setae (*P1* and *Pa*) and puncture (*Pb*) of posterior group just back of middle of head; *P1* slightly back of the level of *Adf2*; *P2* postero-dorsad of *P1*; *Pb* between and equidistant from *P1* and *P2*: *A2* *P1* and *P2*

in a straight line; *Pa* approximate to *A3*, nearer to *A3* than to *L1*. Lateral seta (*L1*) closely approximate to *A3*; on the level of *Adf2;* puncture (*La*) postero-ventrad of *L1*, remote, nearly in a line with *L1* and *A3*. Ocellar setae well separated; *O2* equidistant from *O1* and *O3*, postero-ventrad and approximate to Ocellus *I; O1* ventrad and approximate to Ocelli *II* and *III; O3* remote from and ventrad to *O2;* puncture *Oa* postero-ventrad of Ocellus *VI*, lying in a line and about midway between *O3* and *SO2*. Subocellar setae triangularly placed; puncture *SOa* nearly on a line between *SO1* and *SO3*, approximate to *SO3*. Genal puncture (*Ga*) antero-dorsad of seta *G1*.

Labrum with anterior lateral margins rounded; median incision broadly triangular, moderately deep; seta *M2* postero-laterad of *M1*, slightly nearer to *M1* than to *M3*; *M3* and *LA3* well back from anterior margin of labrum; *La3* back of the level of *M3; La1* and *La2* closely approximate; *La1* on the level of *M1;* puncture midway between *M1* and *M2*.

Epipharyngeal shield minute. Epipharyngeal setae triangularly grouped near anterior margin of labrum; short, sharply pointed, and triangular. Epipharyngeal rods indicated by their posterior projections only ; these are rather short.

Labium and maxillae normal; posterior half of submentum broadening out sharply. Maxillulae normal with well-developed spined lobes.

Pupa.—(pl. 13, figs. 80, 81). Short; stout; abdominal segments abruptly tapering; smooth; no hairs or spines except for a transverse row of long, slender, shortly hooked, hair-like spines at extreme caudal end; wings extending to ventro-caudal margin of 4th abdominal segment; cephalic extremity rounded; epicranial suture present; vertex represented by a narrow, long, triangular area adjacent to each antenna; labrum, pilifers, and maxillary palpi well developed; labial palpi represented by a small polygonal piece at extremity of labrum; pro and mesothoracic legs not extending cephalad between sculptural eye piece and antenna; sculptured and glazed eyes distinguishable; femora of prothoracic legs clearly indicated; prothoracic legs extending half the wing length; mesothoracic legs and antennae extending to tips of wings; metathoracic legs not discernible; suture between 8th and 9th abdominal segments indistinct; dorsal suture between 9th and 10th abdominal segments appreciable, bordered cephalad by a prominent, flat, smooth, narrow ridge; spiracles small, round, protruding; anal opening on ventral surface, rather well forward of caudal end; genital and anal openings long, slit-like in both sexes; no cremaster.

Specific description—larva.—Full grown, 20–22 mm. long, by 3.5 mm. broad. Body whitish on underside suffused with faint pinkish

along ventro-lateral surface; along the sides a yellowish suffusion extending in a broad, ill-defined band the entire length of the body; above this, reaching half way on dorsum, a smoky fuscous suffusion; mid-dorsum sordid whitish faintly suffused with yellow and pinkish; in some specimens the entire dorsal half of the body is a bright ocher yellow; in others the yellow lateral markings are replaced with an ill-defined longitudinal striping of dull reddish pink; legs pale yellowish, a short dash of dark brown at the outer angle of the end of each segment; tarsal claws brown; crochets of prolegs yellowish brown, 68–74 alternating long and short; thoracic shield pale yellow dotted and mottled with dark brown; anal shield pale yellow dotted with brown; body tubercles small, brown; chitinized areas surrounding them whitish; setae dark brown, rather long; *IIIa* of abdominal segments absent; spiracles pale yellow, easily discernible but not conspicuous. Head pale yellowish-brown, irregularly and thickly mottled with darker brown; color quite variable in different specimens, in some of the darker ones the mottlings almost black and the head color very dark brown; chitinous edges of mouth rim and base of mandibles black; ventral side of head yellow in some specimens, yellowish brown in others; ocellar pigment pronounced under each ocellus, not continuous; setae and punctures of ultra posterior group not distinguishable with certainty.

Pupa.—Brown, little or no darker at extremities; sutures dark brown, those between abdominal segments indicated by a fine even line; a narrow, brown line along the outer margins of the wings; spiracles dark brown; dorsal ridge bordering furrow between 9th and 10th abdominal segments blackish brown; hairs on caudal extremity yellowish; male and female (normal specimens) 9 mm. long, 3 mm. broad at middle of body.

EUZOPHERA OSTRICOLORELLA Hulst.

Plate 7, fig. 42; plate 11, figs. 69, 70, 72, 73; plate 13, fig. 82.

Euzophera ostricolorella HULST, Dyar, List N. Amer. Lep., No. 4829.

This species is one of the very few Lepidoptera associated with the tulip tree (*Liriodendron tulipifera*). The larvae mine the bark and are quite common in the neighborhood of Washington City and further south. Large numbers of larvae and pupae were collected by Mr. J. E. Smith during the spring and early summer of 1913 at various points in North and South Carolina. From these several moths were reared during May, June, and July of the same year. The writer has collected full grown larvae in the neighborhood of Washington during late August and had them bring forth moths during September. In one instance a full grown larva was found by Mr. T. E. Snyder of the Bureau of Entomology as late as December 21, 1912. The species evidently overwinters as larva in the mine and quite

possibly produces a couple of generations a year. The larvae attack the larger trees and these only near the base and usually on the side away from the sun or in spots where the bark is continuously moist. They bore into both the cambium and the rough outer bark, making a short, irregular gallery within which they spin a thin silken cocoon when ready to pupate. On emergence of the moth the pupa skin remains within the cocoon. The mine itself is stained black by the watery frass but is otherwise free of accumulations. While very few trees are uninvested they do not seem to suffer much from the attack and I have never found the larvae in smooth or thoroughly dry bark or anywhere except at the base of the tree. A full description of the larva and pupa follows.

General characters larva.—(pl. 7, fig. 42; pl. 11, figs. 69, 70, 72, 73).

As in *Dasypyga* except as follows:

Cylindrical; fairly stout. Crochets in a complete circle; triordinal; one of the shortest hooks alternating with each of the longer. Spiracles slightly oval (nearly circular) in outline; spiracle of 8th abdominal segment larger than that on prothorax. Tubercles heavily chitinized; prothorax with *IIa* well above the level of *Ia*, closely approximate to puncture *y*, puncture *y* directly dorsad of *Ia*, *IIb* nearly on the level of *Ia*, remote from *IIa*, *IIc* nearer to *Ic* than *Ic* is to *Ib;* proleg bearing abdominal segments with *II* appreciably lower than *I;* on 8th abdominal segment *II* considerably higher than *I; VII* unisetose on abdominal segments 8 and 9; *V, IV* and *VI* of 9th abdominal segment in a vertical line.

Head somewhat ovoid; rectangular in outline viewed from above; greatest width back of middle of head; incision of dorsal hind margin about one-third the width of the head; distance between extremities of dorsal hind margin a little over one-third the width of the head. Frons reaching middle of head; considerably longer than wide; longitudinal ridge shorter than frons; adfrontal sutures extending to incision of dorsal hind margin.

Ocelli *I* and *II* approximate; *II* and *III* approximate.

Frontal seta (*F1*) nearer to *Adf1* than *Adf1* is to *Adf2; P2* posterolaterad of *P1*, on a line with *P1* and *F1; Pa* equidistant from *A3* and *L1; L1* forward of the level of *Adf2* or *P1;* puncture *La* directly posterior to *L1*, remote; *O1* lying immediately between Ocelli *II* and *III*, puncture *Oa* approximate to Ocellus *VI*, lying between Ocellus *VI* and *O3;* puncture *SOa* lying well within the triangle of the subocellar group, equidistant from *SO1* and *SO3* and a trifle nearer to them than to *SO2* genal puncture (*Ga*) anterior to the seta (*G1*).

Labrum with median incision rather shallow; *La1* and *La2* not closely approximate; *La1* on the level of *M2* and *La2* on the level of *M1;* puncture closely approximate to *M2*.

Pupa.—(pl. 13, fig. 82). Faintly pitted on dorsum, otherwise smooth; as in *Dasypyga* except:

More gradually tapering; vertex represented by very small triangular areas adjacent to antennae; 8th, 9th, and 10th abdominal segments fused; no distinguishable suture, or dorsal prominence indicating same, between 9th and 10th abdominal segments; anal opening on ventral surface close to caudal extremity.

Specific description—Larva.—Full grown, 25–30 mm. long by 4 to 4.5 mm. broad. Body sordid whitish; legs, crochets, spriacles, thoracic and anal shields, body setae and chitinous areas around tubercles dark smoky brown; thoracic shield sharply divided by a rather broad, whitish median line; around each proleg below the coxal setae (*VII* and *VIII*) a narrow brown chitinous ring; crochets 70–80; setae moderately long; *IIIa* of abdomen easily discernable. Head rich mahogany brown, the more heavily chitinized portion, black; ocellar pigmentation weak, not continuous; setae and punctures of ultra-posterior group easily distinguishable in a somewhat irregular line continuous with *P1*, *Pb*, and *P2*.

Pupa.—Color brown as in *Dasypyga;* 13 to 14.5 mm. long, 3.5 to 4 mm. broad at middle of body.

Family PYRALIDAE.

Subfamily THYRIDINAE.

HEXERIS ENHYDRIS Grote.

Plate 6, fig. 32; plate 7, fig. 39; plate 8, figs. 47, 48, 49, 50, 51; plate 13, figs. 83, 84.

Hexeris enhydris GROTE, Dyar, List N. Amer. Lep., No. 4137.

Two males of this species were reared May 29 and June 20, 1917 (under Hopk. U. S. Nos. 14996 and 15101) from pupae found in stems of "Sea grape" (*Coccolobis uvifera*) at Miami Beach, Florida. According to Mr. T. E. Snyder of the Bureau of Entomology, who collected the material, the larvae mine and kill the young branches of the trees and are present in such numbers as to be of considerable economic importance. Dr. H. G. Dyar, who very kindly determined the moth, informs me that its early stages and life history are unrecorded. Therefore since it is also the type of the genus *Hexeris* a full larval and pupal description is given.

The male genitalia of the moth is figured on plate 6. (Fig. 32.)

General Characteristics—Larva.—(pl. 7, fig. 39; pl. 8, figs. 47, 48, 49, 50, 51.) Cylindrical; stout; tapering sharply at last three caudal segments; 9th abdominal segment greatly reduced. Legs and prolegs normal. Crochets irregular in length but predominantly uniordinal and in a complete circle. No anal fork. Prothoracic shield broad, faintly divided by narrow median line. Spiracles conspicuous; very narrowly elliptical, almost slit-like on abdominal segments 1 to 7;

prothoracic spiracle broader and more than twice the size of smaller abdominal spiracles; 8th abdominal spiracle very large, broadly elliptical, near caudal margin of the segment and facing caudal extremity of the body. Body tubercles inconspicuous; various body areas heavily chitinized. Body setae normal; prothorax with *IIa* dorso-caudad of *Ia*, puncture *y* between *Ia* and *IIa*, approximate to *Ia*, puncture *z* dorsad of and approximate to *Ib*, *IIb* slightly above the level of *z*, *IIc* widely remote from *IIb*, closely approximate to and below *Ic*, in a line with *Ic*, *Ib*, and *Ia*, seta *III* absent; meso and metathorax with *IIa* anterior or antero-laterad of *IIb*, *IV* anterior to *III*, rather remote, *V* absent, *VI* bisetose; proleg-bearing abdominal segments with *II* considerably lower than *I*, *III* dorso-caudad of the spiracle, *IV* and *V* on the same level but rather well separated, *I*, *III*, and *IV* in a vertical line, group *VII* triangularly placed; abdominal segment 7 with *VII* unisetose; abdominal 8 with *II* on the level of *I*, *II* and *III* in a vertical line almost over the spiracle, *IV* and *V* in a longitudinal line well forward of and slightly lower than the spiracle, *VII* unisetose; abdominal 9 with *I* antero-laterad of *II*, equidistant from *II* and *III*, *IV* and *V* united; *VI* present, *VII* unisetose; setae *VIII* much more widely separated on abdominal segment 9 than on abdominal 8.

Head partially retracted within prothorax; ovoid-spherical; broadly ovate in outline viewed from above; as wide as long; greatest width well back of middle of head; incision of dorsal hind margin very slight; distance between extremities of dorsal hind margin over one-third the width of the head. Frons pentagonal, narrow, short, not reaching to middle of head; longitudinal ridge longer than frons adfrontal sutures nearly paralleling the adfrontal ridges, meeting longitudinal ridge just back of the end of frons. Projection of dorsal margin over ventral a trifle more than half the diameter of the head. Ocelli six; *V* and *VI* well separated from the rest. Epistoma normal.

Frontal punctures close together on a level with frontal setae; *Adf2* at beginning of longitudinal ridge; *Adf1* closer to *Adf2* than to *F1*; *Adfa* between *Adf1* and *Adf2*.

Epicranium with the normal setae and punctures. Anterior setae in very slightly obtuse angle; *A1* and *A2* rather close together; *A3* remote from *A2*; punctures *Aa* remote from *A2*, closely approximate and dorsad to *A3*. Posterior setae and punctures well separated; *P2* postero-dorsad of *P1*; puncture *Pb* postero-laterad and remote from *P2*; *Pa* on a line midway between *P1* and *L1*; the punctures *Aa*, *Pa*, and *Pb* lying almost in a straight line. Lateral seta (*L1*) well above lateral margin, as far from *A3* as *A3* is from *A2*; puncture (*La*) postero-laterad of *L1*. Ocellar setae lying almost in a vertical line; *O1* approximate to and dorsad of Ocelli *II* and *III*; *O2* antero-ventrad of Ocellus *I*, in a line with Ocelli *VI* and *I* and

seta *A3;* puncture *Oa* between *O2* and ocellus *VI; O3* ventrad of *O2*, remote, well below the level of Ocelli *V* and *VI.* Subocellar setae triangularly grouped, nearly equidistant; puncture *SOa* equidistant from *SO2* and *SO3.* Genal seta (*G1*) antero-ventrad of the puncture (*Ga*).

Labrum rather short with median incision a shallow triangular notch; seta *M2* postero-laterad and closely approximate to *M1; M3* on the level of *La3*, close to anterior margin of labrum and remote from *M1* and *M2; La1*, *La2*, and *La3* along anterior lateral margin; *La1* and *La2* close together, on the level of *M2* and *M1*, respectively; puncture posterior to *M-2.* Epipharyngeal shield conspicuous, completely surrounding the notch. Epipharyngeal setae narrow, pointed, rather long; situated well back of anterior lateral margin of labrum. Epipharyngeal rods well developed, continuous under setae *La1*, *La2* and *La3* and extending as far as *M3;* posterior projections long, slender.

Maxillulae (fig. 49) with large fleshy lobes densely clothed with fine hair-like spines; a lateral row of small, tooth-like blades similar to those in the Aegeriidae.

Pupa.—(pl. 13, figs. 83, 84) Long; cylindrical; perceptibly tapering only from abdominal segments 7 to 10; caudal end rounded; 7th abdominal segment free in both sexes; appendages soldered to each other; a belt of heavy thorn-like spines on abdominal segments 7 to 10; primary setae also present, otherwise smooth; wings extending to anterior-ventral margin of 5th abdominal segment; cephalic end rounded, smooth; epicranial suture not distinctly indicated; vertex as long as prothorax; prothorax much shorter than mesothorax; pilifers very large; maxillary and labial palpi not indicated; pro and mesothoracic legs not extending cephalad between sculptured eyepiece and antennae; femora of prothoracic legs clearly indicated; meso and metathoracic legs extending beyond wings; antennae extending only two-thirds the wing length; maxillae short, not over half the wing length; no dorsal suture between 9th and 10th abdominal segments; anal and genital openings slit-like in both sexes; anal rise not armed; cremaster absent; spiracles slightly produced.

Specific description. Larva.—Full grown, 20-22 mm long, by 4.5 mm. broad. Body of mature larva white with thoracic shield and chitinized areas to 8th abdominal segment pale yellow; anal shield and dorsal plate of 9th abdominal segment dark brown; other chitinized areas of 8th, 9th and 10th abdominal segments smoky fuscous; legs yellow; tarsal claws brown; setae short, yellowish brown, crochets long, dark brown; 60-64; prolegs with a narrow brown ring about coxal lobe between coxal setae and crochets; spiracles black. Head pale yellow; anterior and postero-lateral margins of epicranium

brown; mandibles brown; tips and attachments of mandibles and mandibular attachments of epicranium black; setae of post mentum, broad and flattened; ocellar pigment black, individual under each ocellus. In earlier stage larvae the head and all chitinized areas about tubercles are dark smoky fuscous, being quite conspicious.

Pupa.—Light brown, slightly darker at caudal and cephalic ends; spines of last three abdominal segments dark brown; attachments of forewings forming a slightly raised shoulder, blackish brown; spiracles black, that on 8th abdominal segment only slightly larger than the others; metathoracic legs extending as far beyond mesothoracic as mesothoracic legs extend beyond the extremeties of wings; prothoracic legs extending a trifle beyond tips of antennae; maxillae only a little over half the length of antennae; male 16 mm., female 19 mm. long, 4.5 mm. wide.

The Pyraloid origin of this genus is distinctly shown in the large pilifers of the pupa and in several larval characters. Abdominal setae *IV* and *V*, it is true, are rather remote which would indicate a more primitive form; but in the other Thyridids I have seen they are closely approximate. Again in *Hexeris* as well as in *Thyris*, *Dysodia*, and *Thyridopyralis* the prespiracular shield of the prothorax bears only two setae (*IV* and *V*), a distinctly Pyraloid character. Fracker's statement[1] that the Kappa (Prespiracular) group of the prothorax is trisetose in Thyridide is obviously an error in observation. The blown larvae of *Dysodia oculatana* in the United States National Museum which he examined are plainly bisetose. The position of alpha (*I*) on the 9th abdominal segment which he also uses is not a reliable family character, in the Pyraloidea at least. As we now classify the groups it is of somewhat less than subfamily value. In *Dysodia* it is higher than beta (*II*) while in *Hexeris* it is considerably below it. On larval and pupal characters, therefore, we will be compelled to consider the Thyridinae, as a sub-family of the Pyralidae closely related to both the Galleriinae and Phycitinae.

EXPLANATION OF PLATES.

Terms used in description of male genital organs.—(Adopted with slight modifications from T. N. Pierce's Genitalia of the British Noctuidae, Liverpool, 1909; Genitalia of British Geometridae, 1914.)

Ae Aedoeagus (chitinous sheath of penis).
Agl Anal angle of harpe.
Cn Cornuti (spines on penis proper, seen through wall of aedoeagus).
Cs Cucullus of harpe.
Fp Caudo-lateral projections from tegumen.
Gn Gnathos.
Hp Harpe (Sensu J. B. Smith and Pierce; Noctuidae="valva," Pierce: Geometridae).

[1] The Classification of Lepidopterous Larvae, Ill. Bio. Monographs, vol. 2, no. 1, July, 1915, pp. 74-75.

Sc Sacculus of harpe.
Se Sicae (name proposed for ventral clasper like organs projecting backward from vinculum in some Gelechiidae).
Si Soci.
Sp Thornlike spine in anal angle of harpe.
A VIII Eighth abdominal segment of moth (a prominent and highly modified part of genitalia in some Gelechiidae).
Tg Tegumen.
Ts Transtilla.
Vm Vinculum (=saccus of Pierce: Geometridae).
U Uncus.

PLATE 1.

Male genitalia (Family Olethreutidae).

FIG. 1. *Evetria ulteriorana*, new species.
2. *Evetria colfaxiana coloradensis*, new variety.
3. *Evetria luculentana*, new species.
4. *Evetria albicapitana arizonensis*, new variety.
5. *Evetria albicapitana* Busck (right harpe, aedoeagus, and right half of tegumen).
6. *Eucosma monitorana*, new species.
7. *Eucosma rescissoriana*, new species.

PLATE 2.

Male genitalia (Olethreutidae and Phaloniidae).

FIG. 8. *Eucosma tocullionana*, new species.
9. *Laspeyresia pallidibasalis*, new species.
10. *Laspeyresia pallidibasalis* (aedoeagus)
11. *Commophila infernalis*, new species (ventral view of organs spread).
12. *Commophila macrocarpana* Walsingham (lateral view of organs unspread).
13. *Commophalia infernalis* (lateral view of organs unspread).

PLATE 3.

Male genitalia (Gelechiidae).

FIG. 14. *Gelechia periculella* Busck (ventral view of organs with modified eighth abdominal segment and aedoeagus removed).
15. *Gelechia periculella* Busck (aedoeagus).
16. *Gelechia nigrimaculella* Busck (posterior half of tegumen showing uncus and gnathos).
17. *Gelechia negundella*, new species (eighth abdominal segment and aedoeagus removed).
18. *Gelechia negundella*, new species (aedoeagus).

PLATE 4.

Male genitalia, etc. (Gelechiidae).

FIG. 19. *Tosca plutonella*, new species (lateral view of male organs unspread).
20. *Tosca plutonella* (ventral view of organs unspread).
21. *Tosca plutonella* (venation of wings of moth).
22. *Evippe prunifoliella* Chambers (lateral view of part of genitalia showing tegumen, uncus, and gnathos).
23. *Gelechia natalis*, new species (detail of genitalia, ventral view, showing uncus and gnathos).
24. *Gelechia natalis* (gentalia, ventral view, unspread)

PLATE 5.

Male genitalia (Gelechiidae).

FIG. 25. *Recurvaria quercivorella* Chambers (lateral view of male organs with eighth abdominal segment spread apart).

26. *Recurvaria quercivorella* Chambers (detail: ventral view of posterior half of tegumen showing lateral flaps, uncus, and gnathos).

27. *Recurvaria moreonella*, new species (detail: ventral view of tegumen and harpes).

28. *Recurvaria moreonella*, new species (detail: ventral view of vinculum with attached aedoeagus and sicae).

29. *Recurvaria moreonella* (lateral view of male organs with eighth abdominal segment removed).

PLATE 6.

Male genitalia (Gracilariidae, Pyralidae, and Blastobasidae).

FIG. 30. *Phyllonorycter felinella*, new species (detail of aedoeagus, lateral view).

31. *Phyllonorycter felinella*, new species (male organs, spread, ventral view).

32. *Hexeris enhydris* Grote (ventral view of organs, spread).

33. *Holcocera augusti*, new species (ventral view of organs, spread).

34. *Eubolepia gargantuella*, new species (ventral view of organs, spread).

Terms used in description of larvae.

A1; A2; A3 Aa=Anterior group of setae and puncture of epicranium.
Adf1, *Adf2 Adfa*=Adfrontal setae and puncture of epicranium.
ADFR=Adfrontal ridge of frons.
ADFS=Adfrontal suture.
E1,*E2*=Epistomal setae.
ER=Epipharyngeal rods.
ES=Epipharyngeal shield.
ET=Epipharyngeal setae.
F1, *Fa*=Frontal setae and punctures.
FR=Frons.
G1, *Ga*=Genal seta and puncture of epicranium.
L1, *La*=Lateral seta and puncture of epicranium.
La1, *La2*, *La3*=Setae of lateral group of labrum.
Lp=Labral puncture.
LR=Longitudinal ridge of frons.
M1, *M2*, *M3*=Median setal group of labrum.
Mxb=Blades of maxillulae.
O1, *O2*, *O3*, *Oa*=Ocellar setae and puncture of epicranium.
P1, *P2*, *Pa*, *Pb*=Posterior group of setae and punctures of epicranium.
SO1, *SO2*, *SO3*, *SOa*=Sub-ocellar setae and puncture of epicranium.
X=Ultra posterior setae and punctures of epicranium.

PLATE 7.

Larval characters (Labra and Epipharynges).

FIG. 35. *Tosca plutonella*, new species (Gelechiidae).

36. *Chrysopeleia ostryaeella* Chambers. (Cosmopterygidae.)

37. *Theisoa constrictella* Zeller (Cosmopterygidae).

38. *Dorata inornatella* Busck (Tineidae).

39. *Hexeris enhydris* Grote (Pyralidae: Thyridinae).

40. *Givira lotta* Barnes and McDunnough (Cossidae).

41. *Dasypyga alternosquamella* Raganot (Pyralidae: Phycitinae)

42. *Euzophera ostricolorella* Hulst (Pyralidae: Phycitinae).

Plate 8.

Larval characters.

Fig. 43. Dorsal view of head capsule showing arrangement of setae (*Tosca plutonella*, new species).
44. Lateral view of head capsule (*Tosca plutonella*, new species).
45. Setal map of first thoracic segment (*Tosca plutonella*, new species).
46. Mine of larva in leaf (*Tosca plutonella*, new species).
47. Dorsal view of head capsule showing setal arrangement (*Hexeris enhydris* Grote).
48. Lateral view of head capsule (*Hexeris enhydris* Grote).
49. Maxillulae (*Hexeris enhydris* Grote).
50. Setal map of first and second thoracic and third, eighth, and ninth abdominal segments (*Hexeris enhydris* Grote).
51. Crochet arrangement of abdominal proleg (*Hexeris enhydris* Grote).

Plate 9.

Larval characters.

Fig. 52. Dorsal view of head capsule showing setal arrangement (*Chrysopeleia ostryaeella* Chambers).
53. Lateral view of head capsule (*Chrysopeleia ostryaeella* Chambers).
54. Dorsal view of head capsule showing setal arrangement (*Theisoa constrictella* Zeller).
55. Ventral view of sections of left lobe of epicranium, showing ocellar and subocellar regions (*Theisoa constrictella* Zeller).
56. Setal map of first and second thoracic and third and ninth abdominal segments (*Theisoa constrictella* Zeller).
57. Setal map of first and second thoracic and third, eighth, and ninth abdominal segments (*Chrysopeleia ostryaeella* Chambers).

Plate 10.

Larval characters.

Fig. 58. Dorsal view of head capsule showing setal arrangement (*Dorata inornatella* Busck).
59. Lateral view of head capsule (*Dorata inornatella* Busck).
60. Dorsal view of head capsule (*Givira lotta* Barnes and McDunnough).
61. Lateral view of head capsule (*Givira lotta* Barnes and McDunnough).
62. Setal map of first and second thoracic and third, eighth, and ninth abodminal segments (*Givira lotta* Barnes and McDunough).
63. Crochet arrangement on abdominal proleg (*Givira lotta* Barnes and McDunnough).
64. Maxillulae (*Givira lotta* Barnes and McDunnough).
65. Setal map of first and second thoracic and third, eighth, and ninth abdominal segments (*Dorata inornatella* Busck).
66. Crochet arrangement on abdominal proleg (*Dorata inornatella* Busck).

Plate 11.

Larval characters.

Fig. 67. Dorsal view of head capsule showing setal arrangement (*Dasypyga alternosquamella* Raganot).
68. Lateral view of head capsule (*Dasypyga alternosquamella* Raganot).
69. Dorsal view of head capsule (*Euzophera ostricolorella* Hulst).

FIG. 70. Lateral view of head capsule (*Euzophera ostricolorella* Hulst).

71. Crochet arrangement on abdominal proleg (*Dasypyga alternosquamella* Raganot).

72. Setal map of first thoracic and eighth and ninth abdominal segments (*Euzophera ostricolorella* Hulst).

73. Crochet arrangement on abdominal proleg (*Euzophera ostricolorella* Hulst).

74. Setal map of first and second thoracic and third, eighth, and ninth abdominal segments (*Dasypyga alternosquamella* Raganot).

Terms used in description of pupa. (Adopted from Miss Edna Mosher, Bull. Ill. State Nat. Hist., vol. 12, article 2, March, 1916.)

a=antenna.
ao=anal opening.
at=invaginations for anterior arms of tentorium.
cl=clypeus.
cs=caudal spines.
cx1=coxa of prothroatic leg.
cx2=coxa of mesthoracic leg.
cx3=coxa of metathoracic leg.
es=epicranian suture.
f=front.
fl=femora of prothoracic leg.
fcs=Fronto-clypeal suture.
g=gena.
ge=glazed eye-piece.
go=genital opening.
lb=labrum.
l1=prothoracic leg.
l2=mesothoracic leg.
l3=metathoracic leg.
lp=labial palpi.
md=mandible.
mp=maxillary palpus.
ms=mesothorax.
mt=metathorax.
mx=maxilla.
p=prothorax.
pf=pilifer.
s=spiricle.
se=sculptured eye-piece.
v=vertex.
wl=mesothoracic wing.

PLATE 12.

Pupae (Tineidae and Cossidae).

FIG. 75. Ventral view of pupa (*Dorata inornatella* Busck).

76. Dorsal view (*Dorata inornatella* Busck).

77. Lateral view of anterior portion of pupa (*Givira lotta* Barnes and McDunnough).

78. Ventral view of pupa (*Givira lotta* Barnes and McDunnough).

79. Dorsal view (*Givira lotta* Barnes and McDunnough).

PLATE 13.

Pupae (*Pyralidae*).

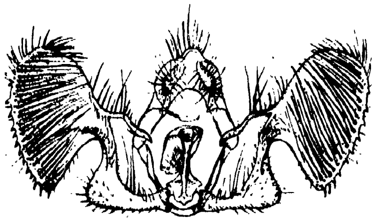
FIG. 80. Ventral view of pupa (*Dasypyga alternosquamella* Raganot).

81. Dorsal view (*Dasypyga alternosquamella* Raganot).

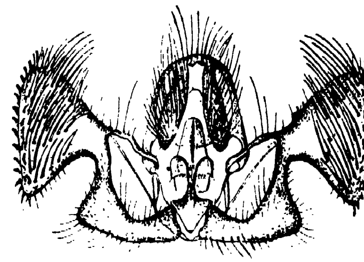
82. Dorsal view of abdominal segments of pupa (*Euzophera ostricolorella* Hulst)

83. Ventral view of pupa (*Hexeris enhydris* Grote).

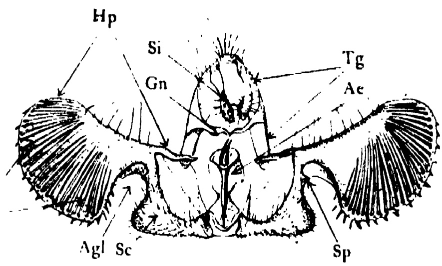
84. Dorsal view (*Hexeris enhydris* Grote.)



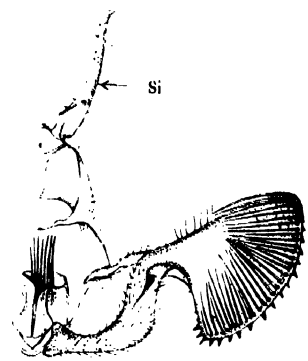
1 *Evetria ulteriorana*



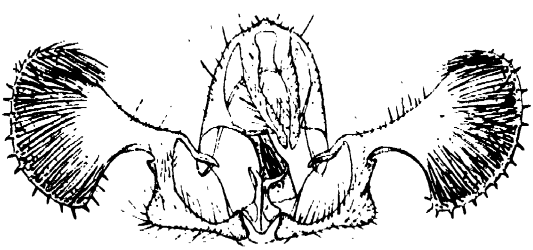
2 *Evetria colfaxiana coloradensis*



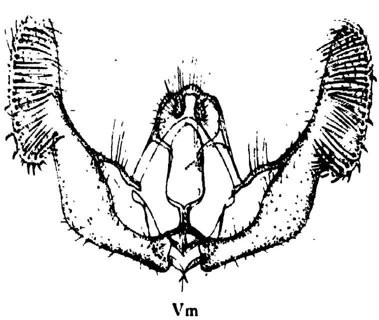
3 *Evetria luculentana*



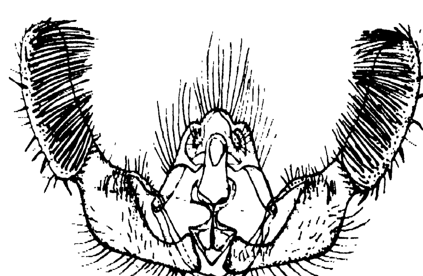
5 *Evetria albicapita*



4 *Evetria albicapitana arizonensis*



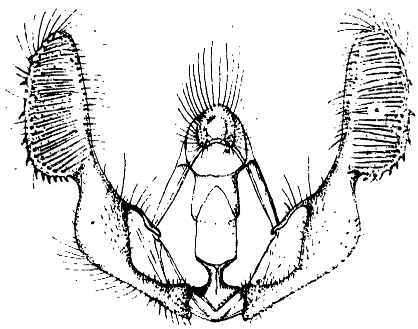
6 *Eucosma monitorana*



7 *Eucosma rescissoriana*

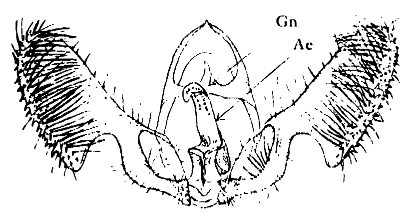
STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

FOR EXPLANATION OF PLATE SEE PAGE 93.

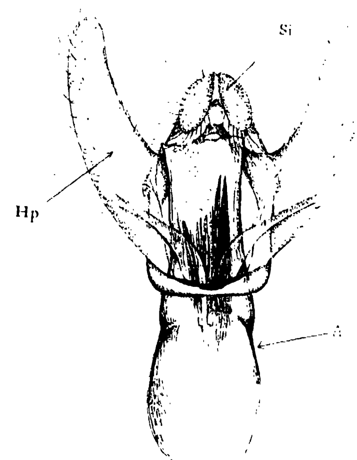


8 *Eucosma tocullionana*

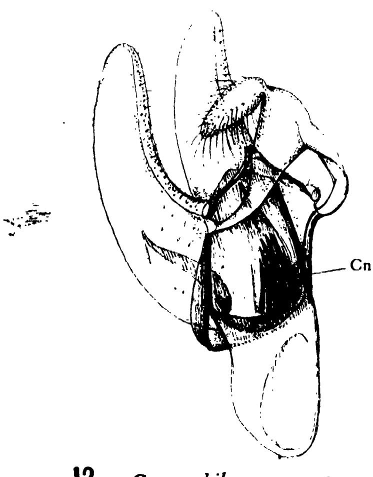
10 *Laspeyresia pallidibasalis*



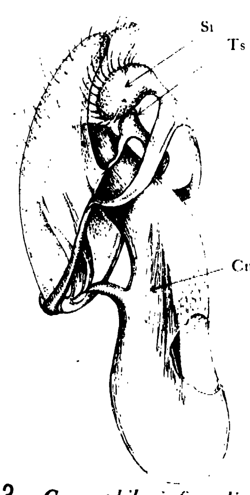
9 *Laspeyresia pallidibasalis*



11 *Commophila infernalis*



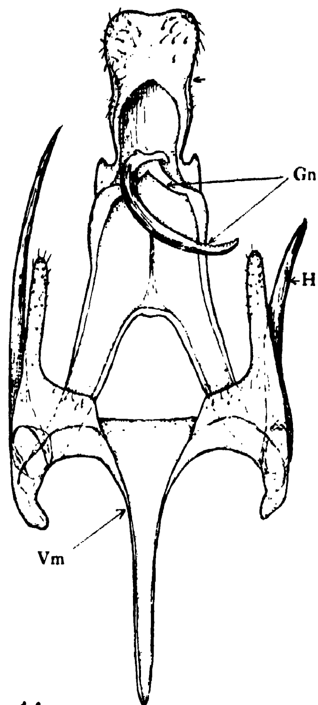
12 *Commophila macrocarpana*



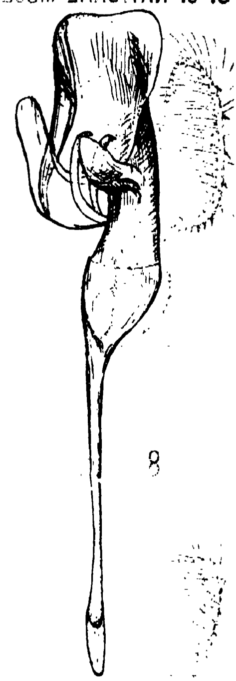
13 *Commophila infernalis*

STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

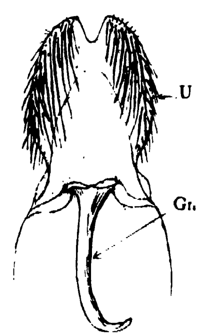
FOR EXPLANATION OF PLATE SEE PAGE 93.



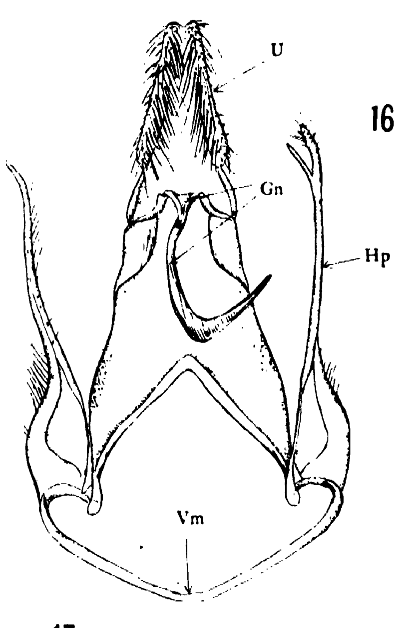
14 *Gelechia periculella*



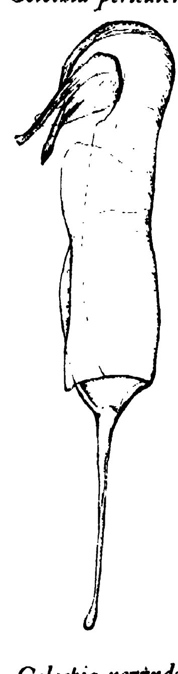
15 *Gelechia periculella*



16 *Gelechia nigrimaculella*

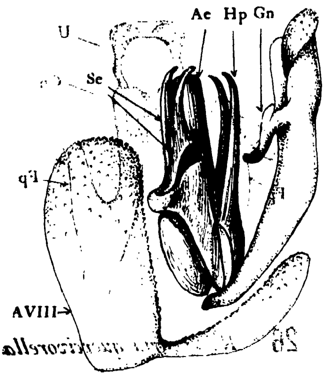


17 *Gelechia negundella*

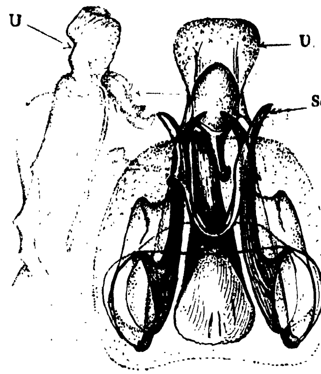


18 *Gelechia negundella*

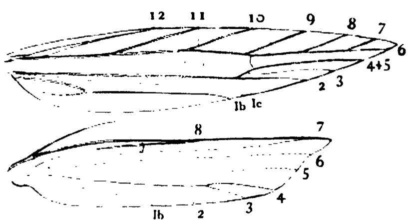
STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.



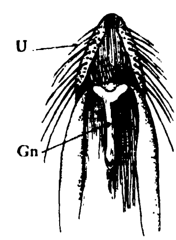
19 *Tosca plutonella*



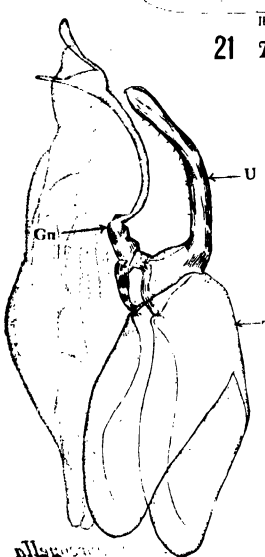
20 *Tosca plutonella*



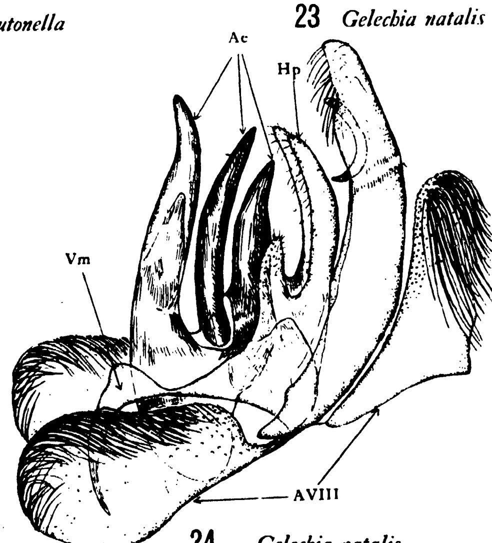
21 *Tosca plutonella*



23 *Gelechia natalis*



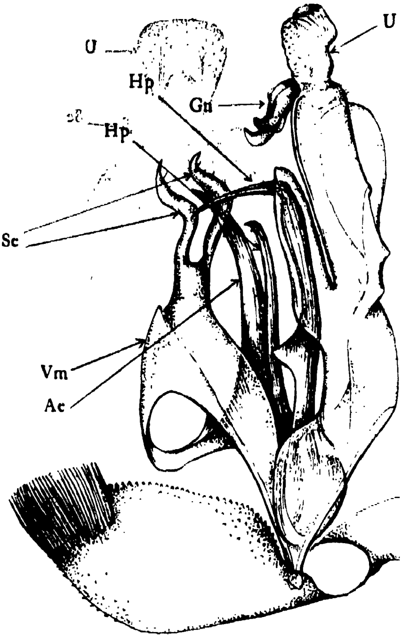
22 *Evippe prunifoliella*



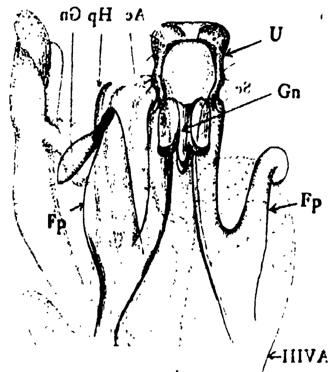
24 *Gelechia natalis*

STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

FOR EXPLANATION OF PLATE SEE PAGE 93.

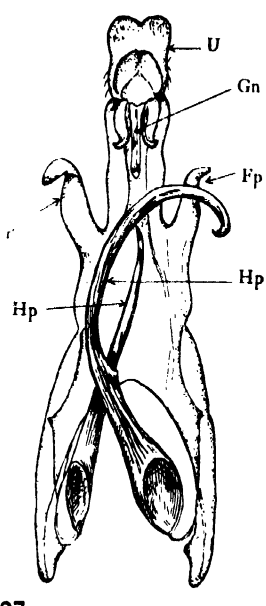


25 *Recurvaria quercivorella*

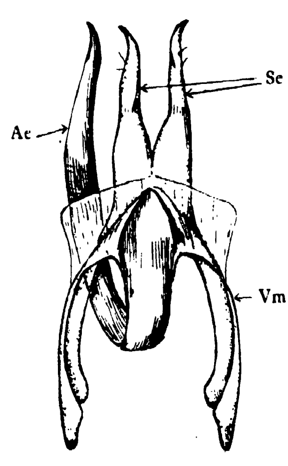


26 *Recurvaria quercivorella*

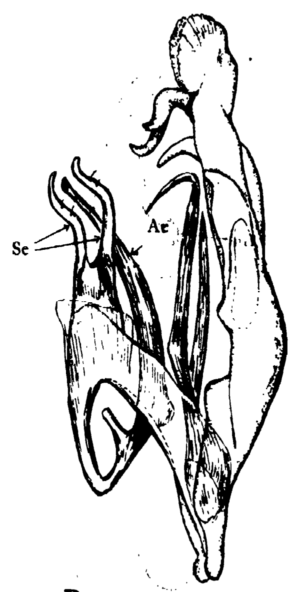
AVIII



27 *Recurvaria moreonella*

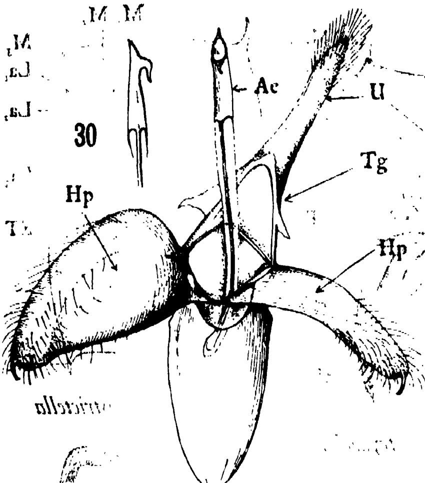


28 *Recurvaria moreonella*

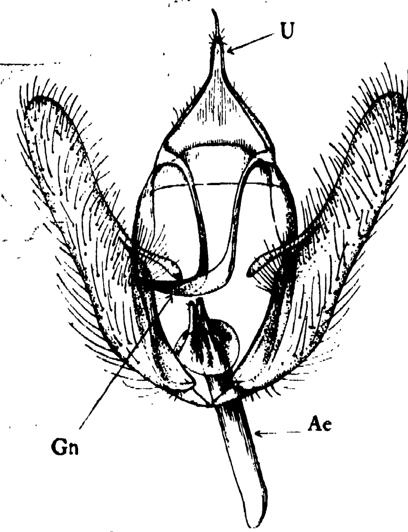


29 *Recurvaria moreonella*

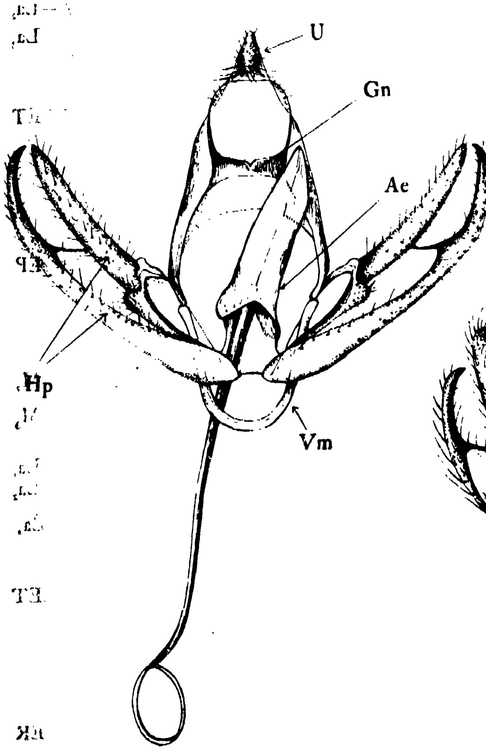
STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

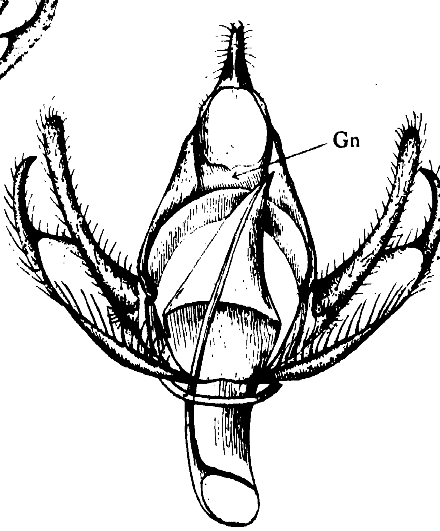


31 *Phyllonorycter felinella*



32 *Hexeris enhydris*

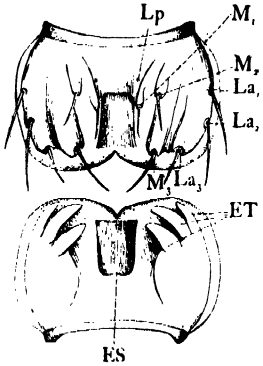




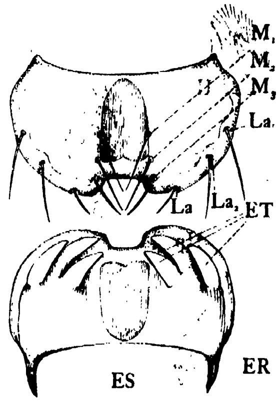
33 *Holcocera augusti*

34 *Eubolepia gargantuella*

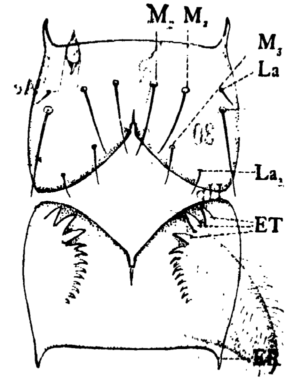
STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.



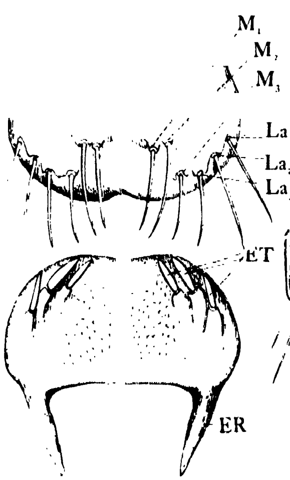
35 *Tosca plutonella*



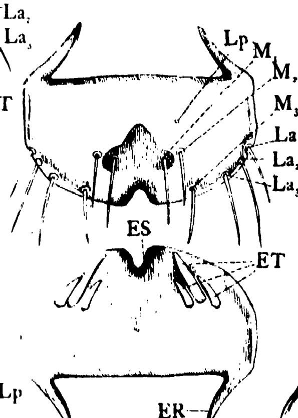
36 *Chrysopeleia ostryaeella*



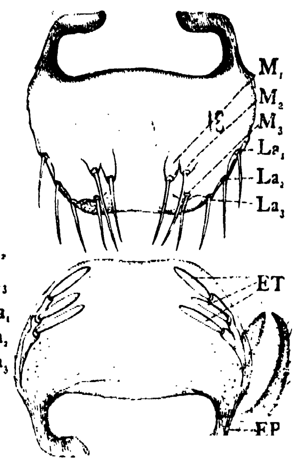
37 *Theisoa constrictella*



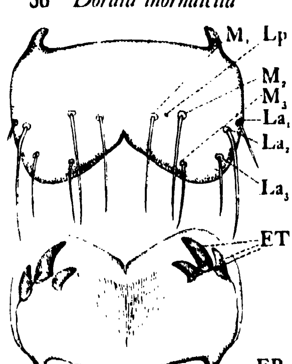
38 *Dorata inornatella*



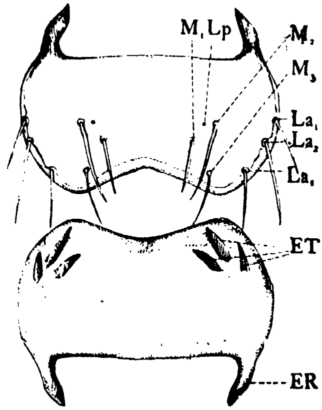
39 *Hexeris enhydris*



40 *Givira lotta*



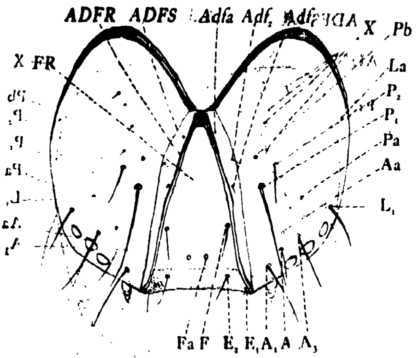
41 *Dasypyga alternosquamella*



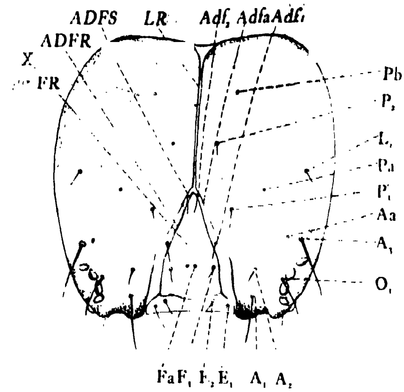
42 *Euzophera ostricolorella*

STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

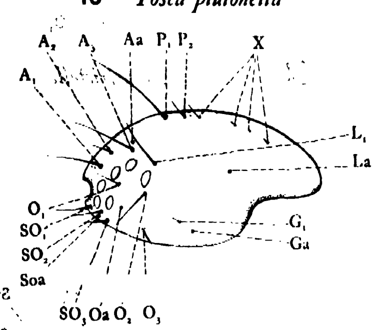
FOR EXPLANATION OF PLATE SEE PAGE 94.



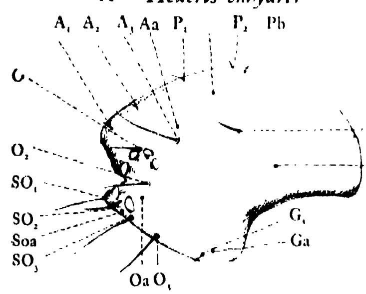
43 *Tosca plutonella*



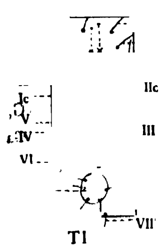
47 *Hexeris enhydris*



44 *Tosca plutonella*

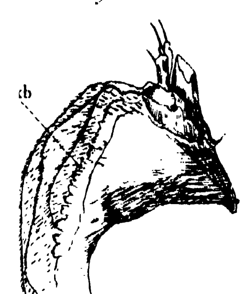


48 *Hexeris enhydris*

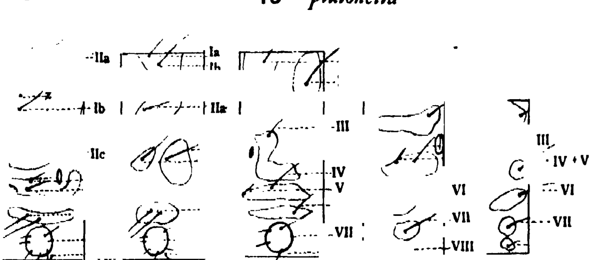


45 *plutonella*

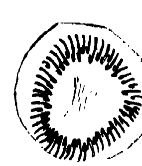
46 *plutonella*



49 *enhydris*

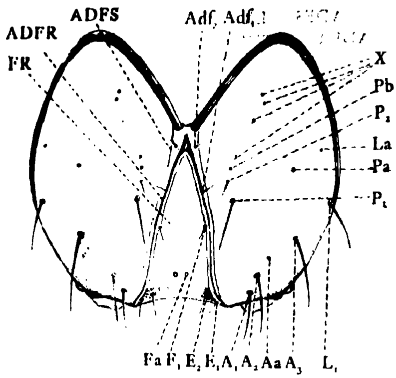


50 *enhydris*

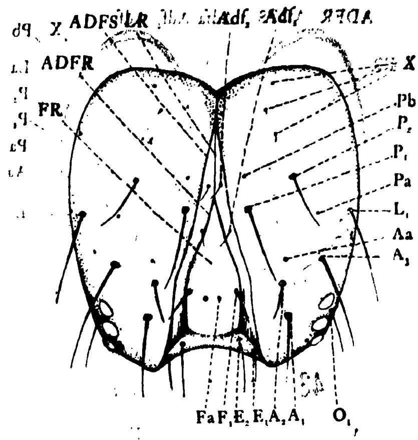


51 *enhydris*

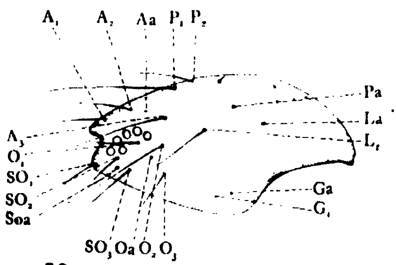
STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.



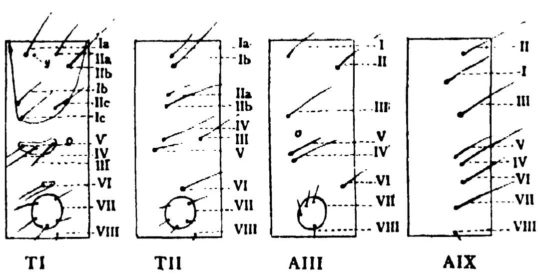
52 *Chrysopeleia ostryaeella*



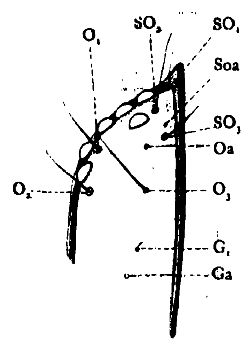
54 *Theisoa constrictella*



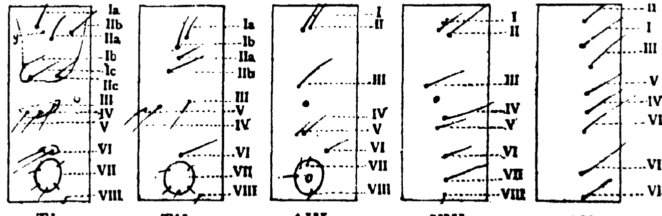
53 *Chrysopeleia ostryaeella*



56 *Theisoa constrictella*



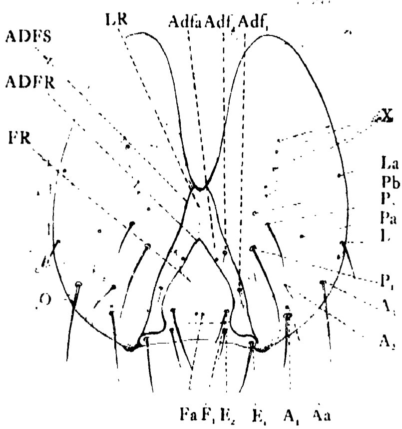
55 *Theisoa constrictella*



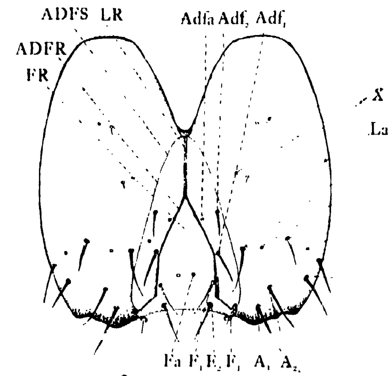
57 *Chrysopeleia ostryaeella*

STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

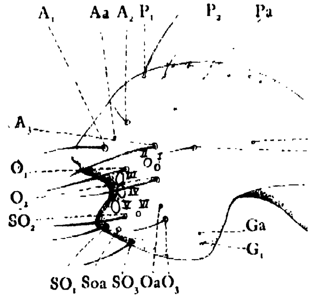
FOR EXPLANATION OF PLATE SEE PAGE 95.



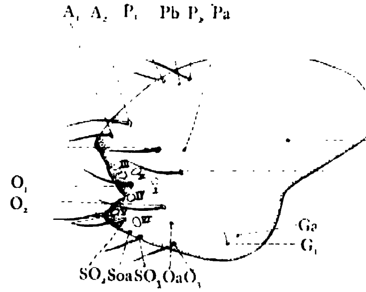
58 *Dorata inornatella*



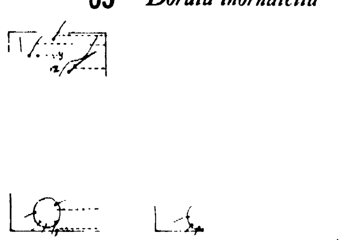
60 *Givira lotta*



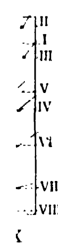
59 *Dorata inornatella*



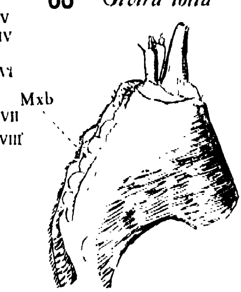
61 *Givira lotta*



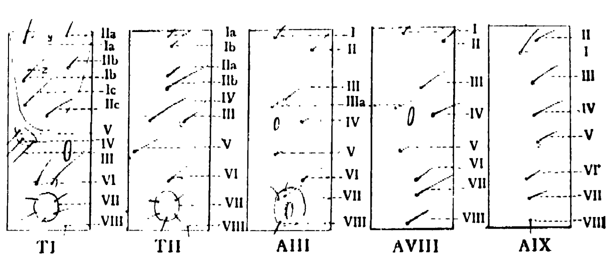
62 *Givira lotta*



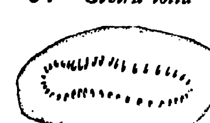
63 *Givira lotta*



64 *Givira lotta*



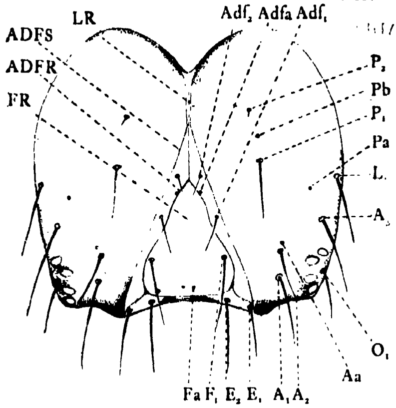
65 *Dorata inornatella*



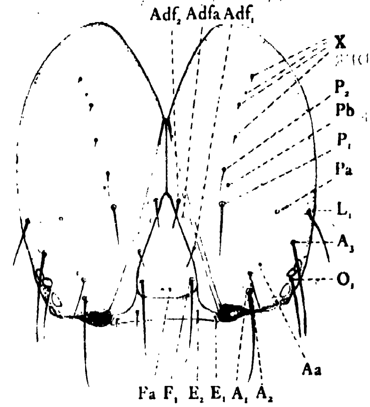
66 *Dorata inornatella*

STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

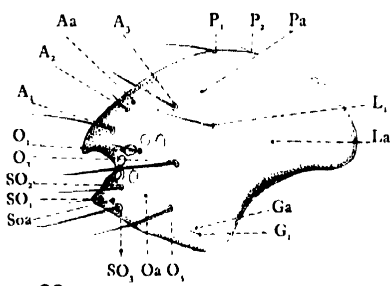
FOR EXPLANATION OF PLATE SEE PAGE 95.



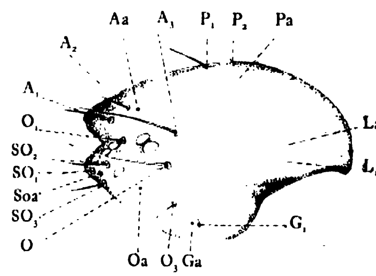
67 *Dasypyga alternosquamella*



69 *Euzophera ostricolorella*

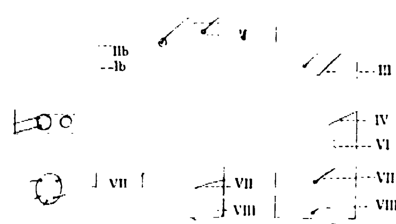


68 *Dasypyga alternosquamella*

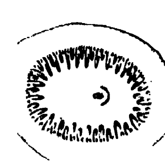


70 *Euzophera ostricolorella*

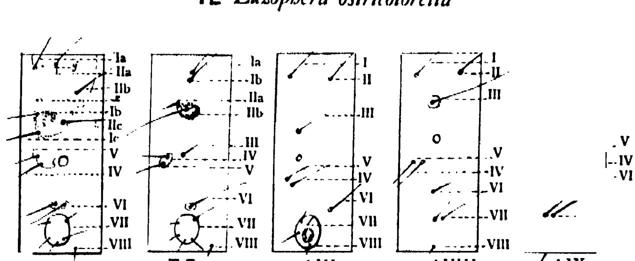
71 *alternosquamella*



72 *Euzophera ostricolorella*

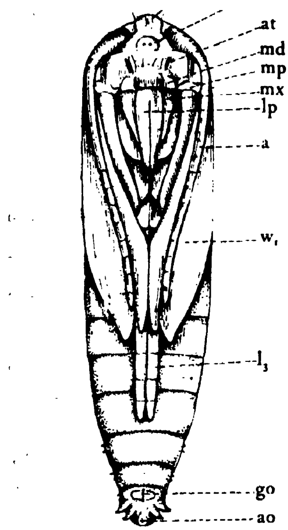


73 *ostricolorella*

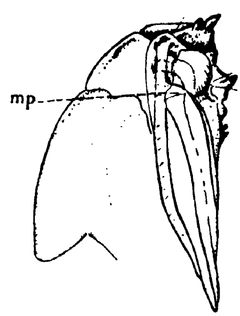


74 *Dasypyga alternosquamella*

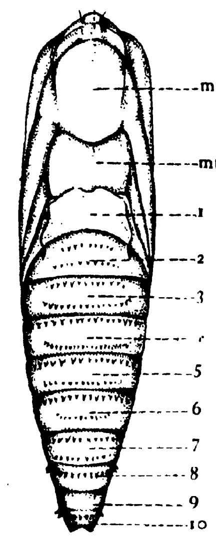
STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.



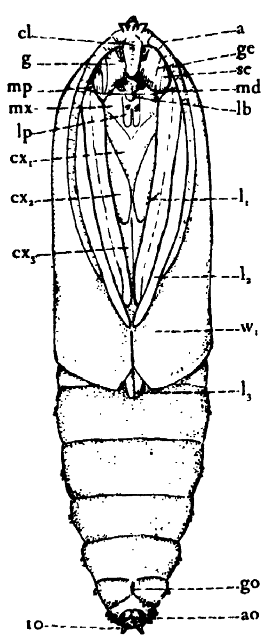
75 *Dorata inornatella*



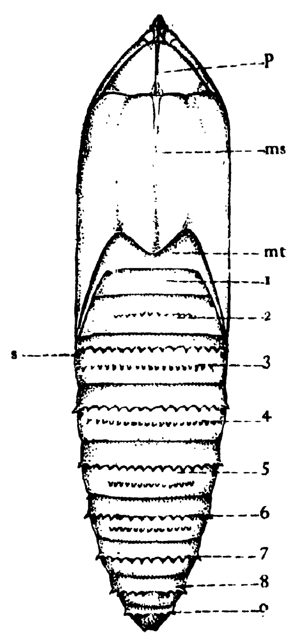
77 *Givira lotta*



76 *Dorata inornatella*



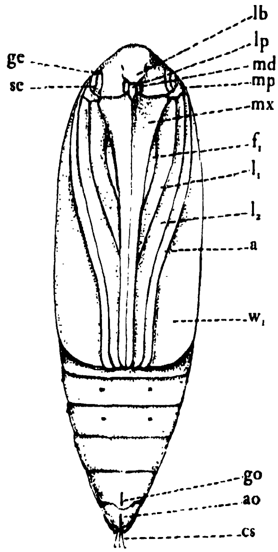
78 *Givira lotta*



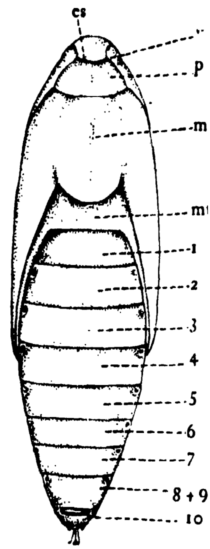
79 *Givira lotta*

STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

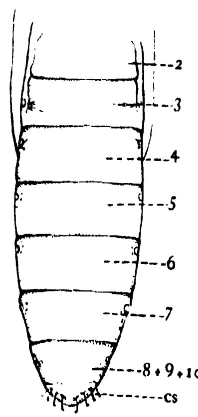
FOR EXPLANATION OF PLATE SEE PAGE 98.



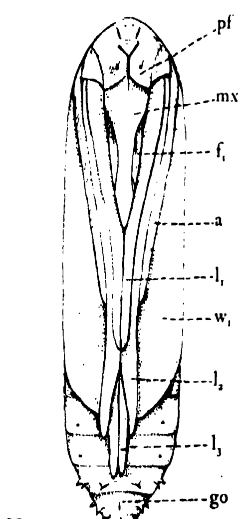
80 *Dasypyga alternosquamella*



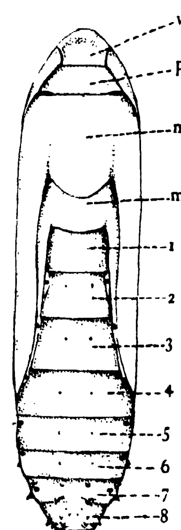
81 *Dasypyga alternosquamella*



82 *Euzophera ostricolorella*



83 *Hexeris enhydris*



84 *Hexeris enhydris*

STRUCTURAL CHARACTERS OF FOREST LEPIDOPTERA.

THE CUMBERLAND FALLS, WHITLEY COUNTY, KENTUCKY, METEORITE.

By George P. Merrill.
Head Curator of Geology, United States National Museum.
With analyses by Earl V. Shannon, Assistant Curator.

This stone, which fell on the 9th of April, 1919, has been the subject of a note mainly descriptive of the fall,[1] by Prof. Arthur M. Miller, of Lexington, Kentucky, to whom the museum is indebted for his efforts in securing a considerable portion of the material.[2] The stone is of so unusual a type that it is worthy of more extensive notice than that given by Professor Miller, and fortunately the amount of the material secured is amply sufficient for the purpose.

On mere casual inspection there is little about the stone to suggest its ultra terrestrial nature. It is safe to say that had it not been seen to fall it would have been passed over by even those having a more or less intimate acquaintance with meteorites. On a broken surface it is of a light ash gray color, of a coarse texture, and might readily be mistaken for a terrestrial pegmatite in which the feldspar had undergone more or less whitening through weathering. Close examination reveals a pronounced brecciated structure (see pl. 15) produced by angular fragments of a chalky white mineral in pieces of all sizes up to 3 or more centimeters imbedded in a finer grey ground of apparently the same nature. Occasional inclosures of a dark gray-brown, almost black color, in one or two instances 3 to 5 cm. in diameter and angular in outline, exaggerate the pronounced brecciated structure which becomes so evident on a polished surface (pl. 15). Abundant flecks of a coal black, highly lustrous material are scattered irregularly through the ground, sometimes so abundant and of such small size as simply to render the rock dark gray in color, or again in shining blotches 10 to 15 mm. in diameter. Investigation shows these to be graphite. No iron or iron sulphide is noticeable on the broken surface and only abundant spots of newly formed iron rust suggest the presence of a ferrous chloride. The fusion crust or rind is inconspicuous, of a

[1] Science, June 6, 1919; also The Mineral Resources of Kentucky, vol. 1, ser. 5, No. 2, July 1919, pp. 110-114.

[2] Two complete individuals weighing respectively 567 and 2,347 grams (see pl. 14), and 13,476 grams of fragments. A 190-gram fragment was donated also by Mr. L. E. Bryant.

yellowish to dirty yellowish-brown color, smooth and extremely thin—a mere skin coating. In several instances there was noted on freshly broken surfaces, small, very thin areas of coal black or smoke-black glass. The cause of this or its relation to the crust is not readily apparent, but it is doubtless the very last fusion product of atmospheric resistance before reaching the earth. The usual pittings or thumb marks are present though the rock has become broken into so many pieces that these are not in all cases markedly evident. (Pl. 14.) A local slickensided movement is developed along the graphitic areas but which in no case observed extends throughout the mass. It would indicate merely such a movement as would take place within a mass under compression, without the production of faults. On the polished surface scattered particles of metallic iron and iron sulphide are readily observed, but they are extremely irregular in their distribution, and much more abundant in the dark, nearly black enclosures referred to. An interesting feature is the peculiar weathered appearance of even a fresh fracture. Fragments broken through the impact of fall and gathered within a few days show dead, lusterless surfaces, as though exposed for many weeks or months. It is probable that this is due to the physical condition of the main constituents, noted later.

In the thin section the white, chalky mineral referred to is seen to make up the main mass of the rock, though in various conditions of fragmentation from almost perfect forms to mere dust (pls. 16 and 17). These are often so crushed, crumpled, and otherwise distorted as to give only undulatory extinctions, and with other optical properties badly obscured. More perfect forms occur as broad plates (pl. 16, fig. 2) with well-defined vertical cleavage lines giving parallel extinctions. Basal sections show imperfect, nearly rectangular prismatic cleavage and the emergence of an optic axis. These facts together with the refractive indices (1.658 +) and the results of Mr. Shannon's analyses (I, p. 100) leave no question but that the mineral is enstatite. In many sections, however, the mineral shows in polarized light irregular, wavy, and interrupted bandings which extinguish alternately as the stage is revolved, in a manner at first suggestive of the polysynthetic twinning of monoclinic pyroxenes or feldspars. In these cases the broader, more continuous bands give parallel extinctions and show in converged light the emergence of a bisectrix. The narrow, often indistinct and pinched out bands give inclined extinctions running as high as 37°. No distinction in color or refractive indices is noticeable, but there is apparently no question but there is here an intergrowth of orthorhombic and monoclinic forms ($\infty P \bar{\infty} = \infty P \grave{\infty}$) in the usual manner. If the analyses made by Mr. Shannon correctly represents this intergrown material (it was selected and analyzed before such an intergrowth was suspected) the proportional amount

of the monoclinic form as indicated by the amount of alumina and lime (1.09 Al_2O_3 and 0.96 CaO) must be very small. The extreme narrowness of the bands giving the inclined extinction is, however, at least partially confirmatory of this.

The chalky appearance of the mineral is plainly due to its physical condition, an abnormal development of the cleavage, which incidentally causes it to crumble away under slight pressure and makes it susceptible of being ground to powder in an agate mortar as readily as so much calcite. Whether this condition is due to the shock which resolved the original mineral into fragments is uncertain, but it would seem most probable. The failure to become recompacted under subsequent pressure might well be ascribed to a lack of moisture, pressure and dry heat alone naturally being less conducive to metamorphism.

In addition to the above, certain of the slides show intergrown with the enstatites in the form of small oval and irregular areas a brilliant polarizing mineral with the sharply developed platy structure characteristic of diallage. The mineral is also nearly colorless with a very faint green tinge, and gives extinction angles measured against the edges of the plates, that is, on clino-pinacoidal sections, as high as 27°. The proportional amount of the diallage is quite variable, some slides showing only an occasional rounded granule and others several of the intergrowths mentioned.

Scattered irregularly throughout the mass of the rock are the scale-like segregations of graphite above noted, sometimes several millimeters in diameter, in connection with which a differential movement has given rise to small areas with slickensided surfaces. In the finer portions, the graphite is so evenly and finely diffused as to impart a dark gray color. Metallic particles are quite inconspicuous excepting on a polished surface, as are also those of iron sulphide. The relatively greater abundance of the metal and sulphide in the dark inclosures above noted, is very evident on the polished surface (pl. 18). No calcium phosphate, maskelynite, oldhamite, osbornite, or other accessory minerals can be detected, although microchemical tests give rise to the usual globular ammonium-phospho-molybdate forms.

A close study of the dark inclusions developed some interesting and unexpected conditions. Examination with a pocket lens of the polished surface of one of the larger inclosures shown in plates 15 and 18 at once suggests a chondritic structure, a suggestion fully borne out by a study of the material in thin section, which shows a dark, obscure, and muddy ground containing numerous illy defined, compressed and distorted radiating, barred, and nearly holocrystalline chondrules of olivine and enstatite, mostly so obscured by a black impregnation that their true mineral nature is scarce recognizable. In these respects the structure so closely resembles that of the McKinney and Travis

County, Texas, stones and others of Meunier's tadjerite group as to suggest a similar origin; that is, as developed from a normal chondrite (aumalite) through a process of heating. It is further to be noted that the dark portions are much richer in metal and, judging from the formation of abundant hydroxide of iron on a freshly cut or broken surface, richer also in ferrous chloride. These facts are borne out by the analyses noted later. The manner in which the metal occurs is interesting and peculiar, leaving no question as to its secondary origin and the foreign nature of the inclusion as well. One of these occurrences is shown enlarged some three diameters in plate 18, the metal in fine threads cutting across the surface in a manner strongly suggesting the figures sometimes given to show the play of lightning during a heavy electrical storm. Aside from these forms the metal at times completely surrounds a chondrule and even penetrates into it in the form of fine threads. The appearance is in entire accord with the idea of its late introduction after the crystallization.

It is evident at once that we have here a meteoric breccia composed of fragments of two quite dissimilar stones. This is sufficiently apparent from both megascopic and microscopic examination. The careful work of Mr. Shannon, the analyses quoted below, is fully confirmatory.

CHEMICAL ANALYSES BY E. V. SHANNON.

Before the intergrown nature of the pyroxenic constituents was suspected the clean, chalky-white portion was carefully sampled, crushed, and separated from possible impurities by the mercuric-iodide gravity solution. The results of an analysis of the powder thus obtained are given in column I below. In columns II and III are given for purpose of comparison previously reported analyses of enstatite from the meteorites of Bishopville, South Carolina, and Hvittis, Finland. The comparison with the enstatite of Hvittis, it will be noted, is particularly close.

Analyses of enstatite.

	Cumberland Falls.	Bishopville.	Hvittis.
	I	II	III
SiO_2	59.53	59.97	59.05
Al_2O_3	1.09	....	1.09
MgO	37.17	39.34	37.10
FeO	.98	.40	.90
CaO	.96	....	.98
(Ba, Sr)O	None.	....	Na_2O .68
NiO	None.	....	K_2O .47
Loss on ignition	.33	....	....
Total	100.06	99.71	100.27

A 70-gram fragment which, so far as could be judged, was representative of the gray brecciated portion of the stone, was selected and, through the courtesy of Dr. George Steiger, ground at the laboratory of the U. S. Geological Survey. This yielded as in column I below. Unfortunately Mr. Shannon was not present during the process of grinding and it is possible that a larger portion of small particles of the dark stone were incorporated in the mass than was surmised from the appearance of the fragment. The probability of this, which was not at first realized, is suggested by the slight excess of magnesia (MgO) and ferrous oxide (FeO) in the bulk analysis over that in the enstatite given above. In columns II, III, and IV are given for comparison previously published analyses of the Busti, Bishopville, and Shalka stones. It will be noticed that so far as the magnesium is concerned the Cumberland Falls stone agrees very closely with that of the first-named, although a trifle higher in silica.

Bulk analyses of the light (major) portion of the meteorite.

	I	II	III	IV
Silica (SiO_2)	55.172	52.73	57.034	52.51
Alumina (Al_2O_3)	.382	....	1.706	.66
Chromic oxide (Cr_2O_3)	.062	....	....	1.25
Phosphoric oxide (P_2O_5)	Trace.	....	....	Trace.
Iron (Fe)	.888	....	.181	.25
Manganese (Mn)	.005	....	....	....
Nickel (Ni)	.059	....	.039	....
Cobalt (Co)	.004	....	....	....
Copper (Cu)	.003	....	....	....
Chromium (Cr)	Trace.	....	....	....
Nickel oxide (NiO)	.123	.78	.538	....
Cobalt oxide (CoO)	Trace.	....	Trace.	....
Ferrous oxide (FeO)	2.916	4.28	1.265	16.81
Lime (CaO)	1.586	1.18	2.016	.89
Magnesia (MgO)	38.734	37.22	33.506	28.35
Manganous oxide (MnO)	.112	.01	.189	....
Soda (Na_2O)	.157	....	1.027	.22
Potash (K_2O)	.150	....	.089	....
Water (H_2O)	.167	Ign.	1.995	....
Sulphur (S)	.784	....	.297	.14
Phosphorus (P)	.034	....	....	....
Chlorine (Cl)	.028	[1] 2.35	....	....
Carbon (C)	.164	[2] .92	....	....
	101.530	99.47	99.882	101.08
Less O for (Cl, S, P)	.569	....	.147	....
	100.961	....	99.735	....

[1] $Na_2S, CaSO_4, CaCl_2$. [2] By ignition.

The results given in column I seemingly bear out the microscopic determinations, and, in connection with the analysis of the white pyroxenic constituents given on page 100, warrant the conclusions

drawn as to the mineral composition of the stone. It is to be noted, however, that qualitative tests show an unusually large proportion of silicate matter soluble in acid, and suggest the need of further chemical work. This must, however, be deferred for the present.

The 0.888 per cent of metal yielded:

Iron (Fe)	92.596
Nickel (Ni)	6.152
Cobalt (Co)	.417
Manganese (Mn)	.522
Copper (Cu)	.313
Chromium (Cr)	Trace.
	100.000

Bulk analysis of the dark chondritic inclosure, yielded:

Silica (SiO_2)	41.683
Alumina (Al_2O_3)	1.537
Chromic oxide (Cr_2O_3)	.591
Ferrous oxide (FeO)	9.399
Nickel oxide (NiO)	.211
Cobalt oxide (CoO)	trace
Phosphoric oxide (P_2O_5)	trace
Lime (CaO)	4.059
Magnesia (MgO)	27.848
Iron (Fe)	12.108
Nickel (Ni)	.747
Cobalt (Co)	.078
Copper (Cu)	.001
Chromium (Cr)	trace
Manganese (Mn)	.088
Potash (K_2O)	trace
Soda (Na_2O)	trace
Chlorine (Cl)	.045
Sulphur (S)	2.464
Phosphorus (P)	.014
Carbon (C)	.449
Ignition (H_2O)	.210
	101.532
O for (Cl,S,P)	1.448
	100.084

In comparison with the other chondritic stones this offers no unusual features.

Treated with dilute hydrochloric acid (sp. gr. 1.06) and sodium carbonate solution in the customary manner, the silicate portion, free from metal and metallic sulphide, yielded 22.582 per cent of soluble matter of the following composition:

Silica (SiO_2)	38.239
Alumina (Al_2O_3)	trace
Ferrous oxide (FeO)	6.566
Nickel oxide (NiO)	.043
Manganous oxide (MnO)	.709
Cobalt oxide (CoO)	trace
Lime (CaO)	5.246
Magnesia (MgO)	49.197
	100.000

The 56.58 per cent insoluble silicates yielded:

Silica (SiO_2)	58. 341
Alumina (Al_2O_3)	2. 705
Ferrous oxide (FeO)	3. 528
Nickel oxide (NiO)	. 295
Cobalt oxide (CoO)	trace
Manganous oxide (MnO)	. 562
Lime (CaO)	5. 073
Magnesia (MgO)	29. 496
	100. 000

This bears out the somewhat unsatisfactory determination of the prevailing orthorhombic nature of the pyroxenic constituent, but the high (5.073) per cent of lime (CaO) is difficult to account for.

The 13.022 per cent metallic portion yielded:

Iron (Fe)	92. 982
Nickel (Ni)	5. 735
Cobalt (Co)	. 599
Manganese (Mn)	. 676
Copper (Cu)	. 008
Chromium (Cr)	trace
	100. 000

The mineralogical composition of the dark inclusion as calculated from the foregoing is as below:

[illegible]	[illegible]
Troilite	6. 760
Lawrencite	. 080
Chromite	. 869
Soluble silicates mainly olivine	22. 582
Insoluble silicates mainly pyroxenes	56. 580
Carbon, mainly amorphous	. 449
Calcium phosphate	trace
Water, hygroscopic	. 210
	100. 552

The most striking features of the stone, aside from its coarse brecciated structure, are the marked evidences of compression manifested in the numerous small slickensided surfaces and the crushed and optically distorted condition of the pyroxenes, as shown both in the hand specimens and in thin sections. It is to be noted that while the original shattering which resulted in the production of the fragments may have been due to impact or explosive action, the mass has since been subjected to pressure under a heavy load whereby the particles have been further crushed and distorted and once more welded into a firm, rock-like mass. These are characteristics of deep seated terrestrial rocks that have been subjected to dynamic metamorphism.

The question naturally arises, is not the distortion so conspicuous in so much of the enstatite due to the crushing which resulted in the disintegration of the original meteorite rather than to any subsequent pressure? This question, I think, may be answered in the negative,

though not with absolute certainty. The study of the sections shows that the line of contact between the light stone and the dark inclosures, while apparently sharp, is, as shown in the thin section, quite irregular, as a rule particles from the one projecting into the other, though the superior hardness and toughness of the dark stone make this a less conspicuous feature than it might otherwise have been. Portions of the enstatite, are, however, jammed into the chondritic stone and particles of the chondritic stone into the enstatite as shown in the accompanying figure. In one instance where a section has been so cut as to cause one of these interpenetrations to appear as an inclusion in the chondritic stone, a minute fault can be traced cutting through both pieces and making itself conspicuous by a slight off-set. Apparently, the admixture of the two kinds of fragments took place prior to the evident compression and both stones were involved. The numerous slickensided areas, sometimes of a few square centimeters dimensions, further testify to the compression and condensation in mass which the stone has undergone.

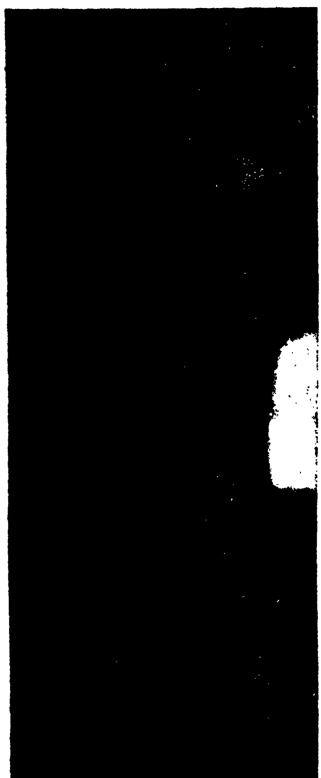


FIG. 1. SHOWING CONTACT BETWEEN DARK CHONDRITIC AND LIGHT ENSTATITE STONE.

These structural characteristics are, as it seems to me, to be accounted for only on the supposition that the detrital matter composed of materials derived from the disintegration of previously consolidated rock masses of at least two distinct types, accumulated on the surface as in the case of an ordinary terrestrial volcanic breccia. Subsequently the beds were deeply buried and through crustal movements the material compressed into its present condition. This carries with it the supposition that the meteorite is but a spawl from a very much larger mass, one of such size, indeed, as to have been subject to such crustal movements as are incidental to mountain making and which find their terrestrial counterpart in regions of maximum disturbance, as in the steep synclinal folds of our southern Appalachians. How large such a mass must be it is impossible to say, but that it must have been of planetary dimensions would seemingly be a safe assumption. In fact, that the fragments are direct evidence of the destruction of some preexisting planet seems a legitimate conclusion.

Incidentally, it may not be out of place to call attention to the fact that this adds one more to the most acidic type of magnesia-rich stones which have been seen to fall and all of which have come to us in a period of a little more than 100 years.[1]

It must be evident from what has gone before that this stone has no exact counterpart among known meteorites and finds no exact place in the prevailing scheme of classification. Disregarding the inclosures of the chondritic stone it differs from the bustites, which chemically it closely resembles, in carrying no appreciable amount of oldhamite, plagioclase, or osbornite, and in its pronounced brecciated structure. From the chladnites it likewise differs in structure and its relatively high magnesia content. Nevertheless, it would seem more nearly related to these groups than others, though on the polished surface it suggests at first a remote similarity to the St. Michel stone described by Borgström and relegated by him to the Rhodites. The Cumberland Falls stone, however, carries no chondrules. It is a breccia, as already noted, and its mineral composition, aside from the chondritic inclusion, is limited almost wholly to the enstatite with an intergrown monoclinic form, sporadic diallage, and small quantities of metal, metallic sulphide, and graphite. In an attempt to make a position for it in the system of classification generally adopted,[2] I will suggest the name of *Whitleyite* (*Wht.*), and define it as a coarse white to gray breccia composed chiefly of enstatite with minor quantities of diallage, metal, metallic sulphide, and graphite, and with sporadic inclosures of a black chondritic stone. The term Cumberlandite might have been selected, but that this name has been preempted by Wadsworth[3] for the terrestrial peridotite of Cumberland, Rhode Island. Whitley is the name of the county in which Cumberland Falls occurs.

EXPLANATION OF PLATES.

Plate 14.

Two complete individuals showing crust and pittings. Actual sizes: 9.5 by 8.5 by 5 cm. and 17 by 16 by 7 cm.; weights, 567 and 234 grams, respectively.

Plate 15.

Sawn and polished fragment showing brecciation and dark inclosures of chondritic stone. Actual diameters, 9 by 12 cm.

Plates 16 and 17.

Photo-micrographs under low magnification (about 5 diameters) showing structure.

Plate 18.

Portion of slice shown in plate 15. Enlarged 3 diameters showing contacts between the fragmental enstatite and the chondritic stone and the peculiar distribution of the metal in the latter.

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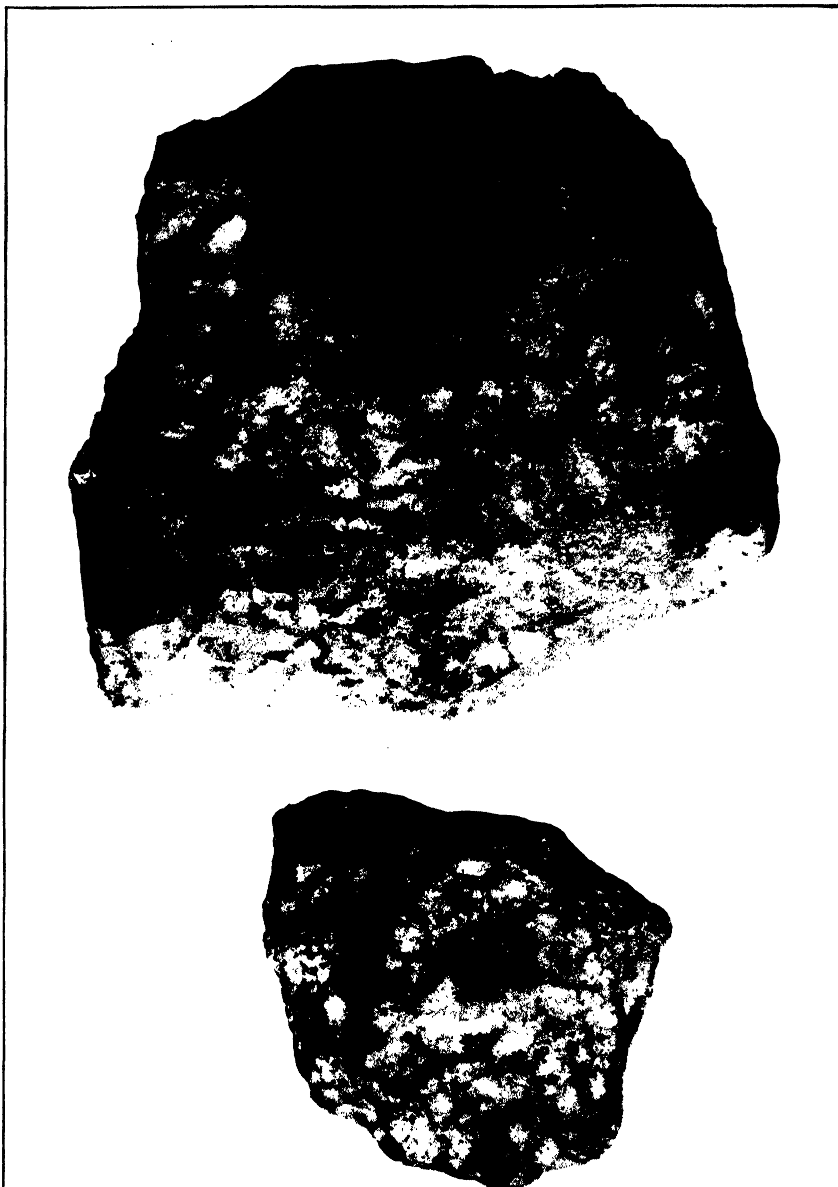
[1] See Merrill, G. P., The Percentage Number of Meteorite Falls and Finds considered with Reference to their Varying Basicity. Proc. Nat. Acad. Sci., vol. 5, pp. 37–39, February, 1919.

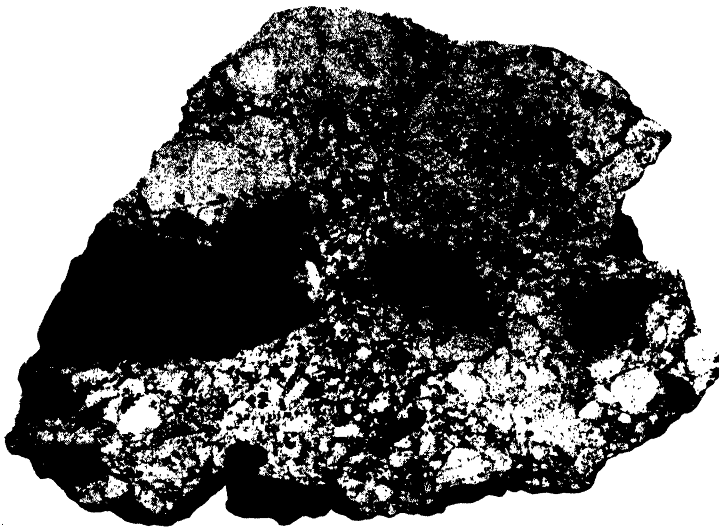
[2] See Wulfing, pp. 446–460.

[3] Lithological Studies, p. 8.



CUMBERLAND FALLS, KENTUCKY, METEORITE.

FOR EXPLANATION OF PLATE SEE PAGE 105.



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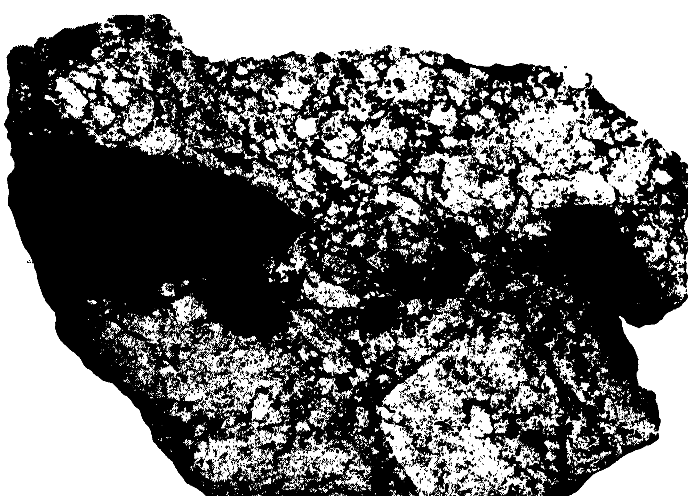


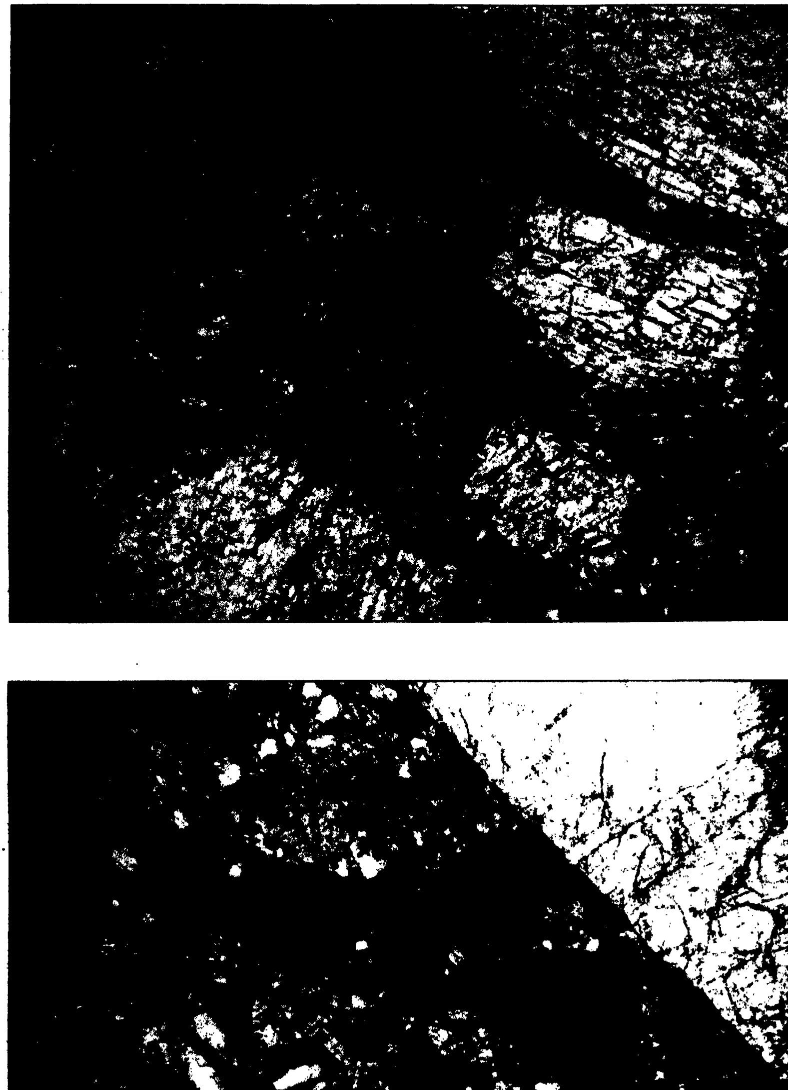
2

CUMBERLAND FALLS, KENTUCKY, METEORITE.

FOR EXPLANATION OF PLATE SEE PAGE 105.

CUMBERLAND FALLS, KENTUCKY, METEORITE.

FOR EXPLANATION OF PLATE SEE PAGE 105.



CUMBERLAND FALLS, KENTUCKY, METEORITE.

FOR EXPLANATION OF PLATE SEE PAGE 133.

CUMBERLAND FALLS, KENTUCKY, METEORITE,

NEW SPECIES OF LEPIDOPTERA IN THE UNITED STATES NATIONAL MUSEUM.

By William Schaus,
Assistant Curator of Insects, United States National Museum.

The species described from Guatemala were all taken by Mr. John T. Barnes and myself during our recent visit to that country; those recorded from northwest Mexico have been generously donated by Mr. B. Preston Clark; in most other cases the name of the donor or collector is mentioned.

Suborder RHOPALOCERA.

Family SATYRIDAE.

PEDALIODES MARIA, new species.

Male.—Wings above fuscous brown with a still darker marginal line, straight on fore wings, lunular on hind wings. Wings below dark brown, the lines darker. Fore wings: a medial curved line in cell; a postmedial line somewhat oblique from costa, almost straight to vein 3, then wavy to inner margin; a submarginal line finely wavy; an indistinct marginal line; a black terminal line. Hind wings: an antemedial line to median, then slightly inset to inner margin; postmedial line inwardly shaded with dark red, lunular between veins 2 and 3, followed by three ocelli, black, circled with yellowish, and containing a white point, the largest ocellus between veins 2 and 3; submarginal line irregular, wavy, outwardly shaded with dark reddish; the marginal and terminal line as on fore wing.

Female.—Not quite so dark, the lines and one or two of the ocelli present on the upper surface; the postmedial line inwardly shaded with dark red. Wings below also paler, especially the terminal space beyond postmedial line, which is decidedly grayish. Hind wings with a small ocellus near costa, and yellow points between veins 4 and 6; the three ocelli toward anal angle as in male.

Expanse.—Male, 43 mm.; female, 45 mm.

Habitat.—Volcan de Santa Maria, Guatemala, 4,500 feet; flying about bamboo in April, July, October, November; not met with anywhere else.

Type.—Cat. No. 22394, U.S.N.M.

Family NYMPHALIDAE.

Subfamily HELICONINAE.

EUEIDES ASIDIA, new species.

Male.—Fore wings black; a reddish brown streak along inner margin expanding before tornus; similar streaks in cell, along median, and on either side of vein 2 suffusing more or less with subterminal spots; an oblong ochreous spot at end of cell, a similar oblique streak between veins 3 and 4, three subapical streaks and a subterminal spot betwwen 4 and 5; subterminal spots on either side of vein 2, the lower one very small. Hind wings ferruginous, the outer margin black. Fore wings below more fuscous, the spots faintly indicated and paler; small white marginal spots at apex and toward tornus. Hind wings below dark brown; outer margin black with paired white spots between veins; costa and subcostal streak dark chocolate brown; a whitish streaky space around end of cell. The female is similar to the male, but has some whitish apical streaks on fore wing.

Expanse.—Male, 68 mm.

Habitat.—Volcan de Santa Maria, Guatemala, in July and November.

Type.—Cat. No. 22395, U.S.N.M.

Evidently a race of *E. vulgiformis* (Butler and Druce) distinguished by the darker spots and pronounced cellular streak, the absence of a white apical spot on hind wing, and the less distinct spots on underside.

Family RIODINIDAE.

PANARA ELEGANS, new species.

Male.—Body and wings black, the fore wings crossed by a reddish orange band from middle of costa to tornus, narrower on costa than at tornus; the cilia at apex white. Hind wings with a broad, dark blue shade on outer margin from below vein 6 to anal angle; the inner margin clothed with black brown hair; cilia black with a few white scales at anal angle. Wings below blackish brown, the band on fore wings deep yellow.

Female.—Black brown, the band on fore wings deep yellow, and widest on costa, the cilia white at apex; hind wings with the cilia almost entirely white.

Expanse.—Male, 33 mm; female, 38 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22396, U.S.N.M.

This genus had not been found previously to occur in Central America.

Family PAPILIONIDAE.

Subfamily PIERINAE.

PRESTONIA, new genus.

Female.—Antennae slender, the tip thickened and slightly booked. Palpi upturned to frons, the third joint very short, conical, and well scaled. Fore wings broad, the costa arched, the apex almost round; neuration as in *Callidryas*. Hind wings with the outer margin and anal angle evenly rounded; the discocellular differs from *Callidryas* in being incurved, almost inangled.

Type of genus.—*Prestonia clarki*, new species.

PRESTONIA CLARKI, new species.

Female.—Thorax black with yellow hairs. Abdomen yellow Wings yellow. Fore wings: clusters of fuscous scaling on interspaces of outer margin from above vein 2 to costal vein. Hind wings: the outer margin from costa to vein 2 broadly orange. Fore wings below: orange shading in cell and on termen where the dark scaling is reduced. Hind wings below: a round purple brown spot on discocellular and a smaller spot above vein 5; a postmedial dark spot on costa; subterminal spots on interspaces above vein 4 suffusing with marginal large reddish purple spots, which are not clearly defined.

Expanse.—62 mm.

Habitat.—Mazatlan, Mexico.

Type.—Cat. No. 22397, U.S.N.M.

I take great pleasure in naming this new genus and interesting species after my friend, Mr. B. Preston Clark.

PIERIS KUSCHEI, new species.

Male.—Palpi fringed with white. Head and thorax black with white hairs. Abdomen whitish with some dorsal fuscous shading. Wings white. Fore wings: costal margin tinged with ocher at base; medially broad streaks of heavy white scaling edging submedian, also veins 2, 3, and lower side of vein 4; a large black spot at end of cell; some black scaling postmedially on either side of vein 4 and above vein 3; terminal black spots on veins increasing in size toward apex where the costa is narrowly edged with black. Hind wings: a fine short black streak on upper part of discocellular. Fore wing below: the apex tinged with dull bone color, the spots as above, more pronounced; a postmedial black spot below vein 3. Hind wings below whitish bone color; the discocellular line thicker; some fuscous scaling beyond lower end of cell; costa finely orange. Female above similar to male, the spots rather more conspicuous; a postmedial black spot at vein 3; the heavy white edging to veins

absent. Underneath similar to male, the bone color of hind wing darker in tone.

Expanse.—Male and female, 56 mm.

Habitat.—Mazatlan, Mexico.

Type.—Cat. No. 22398, U.S.N.M.

Named after its discoverer, Mr. A. Küsche.

Suborder HETEROCERA.

Family AMATIDAE.

ISANTHRENE ILLEGITIMA, new species.

Female.—Body black brown; some white scales on fore coxae, the hind coxae and ventral spots on abdomen on basal segments white; a white spot laterally on thorax below; some white scaling on head behind; red spots on tegulae and shoulders; a white spot on thorax anteriorly; some blue scaling on abdomen forming a line of very faint dorsal intersegmental spots. Wings hyaline, the veins black, the outer margins broadly black. Fore wings: the base black with an angled red spot; discocellular broadly black. Underneath with a tuft of white scales at base of costa on fore wing, the inner margin of hind wing broadly shot with shining white.

Expanse.—32 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22399, U.S.N.M.

ISANTHRENE CAZADOR, new species.

Male.—Head and thorax yellow. Antennae orange red; palpi and legs red; the fore tibiae streaked with black, coxae white; frons vertex, tegulae, and patagia edged with black. Abdomen yellow with black segmental lines expanding into small dorsal spots, the ventral surface black with white and brown transverse lines. Fore wings yellowish hyaline, the veins fuscous; base of costa finely red, yellow streaks below costa, and above and below submedian vein; these streaks not reaching beyond middle of wing; outer margin narrowly black, expanding slightly at apex. Hind wings hyaline white, the termen narrowly, the inner margin more broadly black brown. Underneath the costal margins are crimson, the inner margin of hind wing broadly chrome yellow.

Expanse.—46 mm.

Habitat.—Escuintla, Guatemala.

Type.—Cat. No. 22400, U.S.N.M.

Allied to *I. cajetani* Rothschild.

SPHECOSOMA ROSEIPUNCTA, new species.

Male.—Body yellow; contiguous salmon red spots on vertex; collar and patagia edged with black; black patches on thorax ante-

riorly and posteriorly; abdomen with black bands above and laterally suffusing with a dorsal black line; tarsi fuscous. Wings yellowish hyaline. The veins and margin finely black, expanding very slightly at apices; fore wing with a yellow streak above subcostal vein; a yellow and crimson spot at base of wing.

Expanse.—21 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22401, U.S.N.M.

Very much like *Pheia stratistes* Dyar which also has the base of abdomen constricted.

GYMNELIA FRUTERA, new species.

Male.—Body black, with some scattered metallic blue scales chiefly subdorsally at base of abdomen, on terminal segments, and on thorax below; frons blue; blue paired spots, at back of head and on tegulae; crimson spots on shoulders and dorsally on first segment of abdomen; abdomen below silvery white, becoming orange on next to last segment, the orange extending laterally over two segments; anus black. Wings hyaline somewhat yellowish, the veins and margins finely black, expanding very slightly at apices; base of wings black, more broadly so on fore wing; hind wing with a terminal black spot at anal angle.

Expanse.—25 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22402, U.S.N.M.

The female is slightly larger, the lateral orange space on abdomen does not extend ventrally and is there replaced by a dark gray shade.

LOXOPHLEBIA OMALESIA, new species.

Male.—Antennae black tipped with white. Palpi, head, thorax and legs fuscous brown; fore coxae white; patagia orange red, edged with black; abdomen yellow, the three terminal segments black. Wings hyaline, the veins and margins black, the latter expanding at apices, and slightly at inner angles; fore wings with a black line on discocellular.

Expanse.—25 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22403, U.S.N.M.

COSMOSOMA NETTIA, new species.

Male.—Head, thorax, legs, and antennae black; abdomen yellow, the terminal segment black. Wings hyaline white, the veins and margins black, widest at apices; discocellular on fore wing thick and angled; the black at anal angle of hind wing expanding.

Expanse.—23 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22404, U.S.N.M.

Bears the same relation to *C. hercyna* Druce as *C. melanotela* Dyar bears to *C. hercynacula* Dyar.

COSMOSOMA NASCA, new species.

Male.—Antennae and body black; some metallic blue scaling on frons and thorax; base of abdomen dorsally crimson, ventrally white except on last three segments; red spots on shoulders; coxae silvery white; palpi laterally streaked with white; tarsi terminally white. Wings hyaline white, the veins and margins finely black, the latter expanding slightly at apices; fore wings with discocellular more heavily marked and some black at tornus.

Expanse.—21 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22405, U.S.N.M.

Veins 4 and 5 on forewings are shortly stalked. The tibia on hind legs are nearly twice the length of tarsi with paired spurs just beyond middle.

COSMOSOMA PURULHA, new species.

Male.—Body black with patches of blue scales on frons, vertex, thorax, and abdomen, forming on the latter a dorsal and double lateral series of spots; patagia orange finely edged with black. Wings hyaline, the veins and margins black. Fore wings: an orange streak below costa to terminal black edge, a similar line on inner margin expanding at tornus; a thick black line on discocellular and a black spot below it between veins 2 and 4. Hind wings: the terminal border wider especially at apex. Wings below with orange streaks on costal margins; the black spot below cell in forewings containing an orange streak; the hind wings roughly scaled on apical half of outer margin.

Expanse.—30 mm.

Habitat.—Purulha, Guatemala.

Type.—Cat. No. 22406, U.S.N.M.

Allied to *C. proton* Druce.

COSMOSOMA VARICA, new species.

Male.—Head, collar, thorax, antenna, and legs fuscous brown. Abdomen above light brown, almost white at base; terminal four segments black; venter white. Wings hyaline, the veins black. Forewings: base and termen fuscous brown; spots black; a spot close to cell between veins 2 and 3; a large irregular spot on discocellular; termen expanding at tornus and much more so at apex, being widest between veins 5 and 6, narrowest between veins 3 and 5. Hind wings: outer margin narrowly fuscous brown, expanding very slightly at apex and tornus.

Expanse.—35 mm.

Habitat.—Volcan de Santa Maria, Guatemala, at 5,500 feet.

Type.—Cat. No. 22407, U.S.N.M.

PSEUDOMYA MELANTHOIDES, new species.

Female.—Palpi laterally white. Body fuscous brown; suffusing red spots on vertex; paired red spots on shoulders and thorax posteriorly. Fore wings hyaline the veins, cilia, and margins finely fuscous brown; the base narrowly and inner margin dark brown; a broad medial fuscous brown fascia, expanding somewhat toward inner margin. Hind wings: the basal half hyaline crossed by dark veins, the outer half fuscous brown.

Expanse.—22 mm.

Habitat.—Cayuga.

Type.—Cat. No. 22408, U.S.N.M.

Near *P. nigrizona* Schaus.

SYNTOMEIDA VENADIA, new species.

Male.—Head black, the frons shot, with metallic blue; palpi orange; antenna black, tipped with white. Thorax black, shaded with metallic blue; tegulae and patagia orange, finely edged with black. Abdomen black; a large orange quadrate spot at base; broad segmental orange lines, interrupted dorsally except on last segment; some blue shading dorsally and laterally; anal hairs orange; ventral valve orange, edged with black; yellow ventral band on segments 3 and 4. Fore coxae yellow. Fore wings black; a broad orange streak on costa near base, and fine orange line on inner margin; an orange medial spot from subcostal to submedian, whitish and semihyaline just below cell; a similar postmedial spot from subcostal to vein 2, whitish and semihyaline between veins 2 and 4, vein 3 remaining orange. Hind wings black; a large semihyaline white spot at base from cell to inner margin; a similar postmedial spot from costal margin to near termen, cut by orange veins. Fore wings below black, the spots as above; the orange streak on costa reaching base. Hind wings below as above; basal third of costa and the cell orange.

Expanse.—33 mm.

Habitat.—Presidio, Sinaloa, Mexico.

Type.—Cat. No. 22409, U.S.N.M.

Near *S. hampsonii* Barnes.

CERCOPIMORPHA SYLVA, new species.

Male.—Palpi fuscous, the second and third joints tipped with white; frons brown; vertex, collar, and thorax brown streaked with lilacine gray; abdomen above and laterally yellow, the venter and entire first and anal segments black; fore wings dark slate color, tinged with lilacine, the veins dark brown; costa gray; a fine lila-

cine streak below costa; a broad antemedial dark shade somewhat interrupted in cell; a dark brown spot anteriorly near end of cell; termen dark brown, mottled with grayish white shades. Hind wings fuscous, somewhat semihyaline through and beyond cell. Wings below fuscous gray, the tips of forewing finely paler, the semihyaline streak on hind wing better defined.

Expanse.—28 mm.

Habitat.—Cayuga. Guatemala.

Type.—Cat. No. 22410, U.S.N.M.

Only found in forest during day.

NAPATA CHEJELIA, new species.

Female.—Palpi crimson, tipped with black. Throat, neck, and vertex crimson; frons metallic blue. Tegulae, thorax, and patagia black, a few blue scales on thorax. Abdomen above metallic blue, underneath black, with segmental blue lines; fore coxae metallic blue. Fore wings brown black, the cilia tipped with gray and at apex with white. Hind wings black; two short blue streaks from base. Underneath with broad metallic blue streak on basal half.

Expanse.—29 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 22411, U.S.N.M.

Allied to *N. guatemalena* Druce, but without blue on forewing and with blue on hind wing.

Family ARCTIADAE.

Subfamily ARCTIANAE.

AMAXIA CARINOSA, new species.

Male.—Antennae dark brown. Palpi white in front, black behind edged with crimson. Head crimson with a yellow bar, and a black line between antennae. Tegulae and shoulders yellow. Thorax fuscous gray, the patagia crimson shaded with gray. Abdomen above crimson with a dorsal fuscous spot at base; underneath white. Legs white; fore tibia with a yellow dark edged band. Fore wings: the base to middle of cell, and obliquely to termen above tornus crimson and dark gray, the gray predominating toward costa and is cut by crimson streaks on subcostal, in cell, on submedian and vein 2; this space incloses a large yellow spot on costa near base; a faint yellow streak on base of inner margin, and a postmedial upright yellow line, its outer edge very irregular and edged with black; remainder of wing yellow; a small spot at end of cell; a streak above discocellular; four spots beyond cell from veins 3 to 7; a subterminal spot between veins 2 and 3, and terminal spots on interspaces, all fuscous gray; from vein 3 to costa a series of large subterminal

crimson spots, narrowly edged with fuscous and only separated by crimson streaks on veins; the spots from costa to vein 5 somewhat oblique, the two below vein 5 inset. Hind wings roseate, the costal margin white; black shading on terminal space. Wings below white, the subterminal spots on fore wing fuscous brown.

Expanse.—34 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22412, U.S.N.M.

AMAXIA TIERNA, new species.

Male.—Palpi yellow in front, dark brown with crimson edges behind, and tipped with brown. Head, collar, and shoulders yellow; some roseate and brown scaling between antennae; neck crimson. Thorax gray and roseate; large gray spots edged with crimson on patagia. Abdomen crimson above, white underneath. Fore wings yellow; an interrupted crimson streak on costa at base; a crimson streak on base of inner margin, and a gray, crimson edged spot above it; antemedial steel gray streaks on costa, in cell, and below cell partly edged with crimson, and separated by crimson streaks on veins, the lowest streak followed by a round spot below vein 2, and connected with it by a circular gray line from its basal side which thus incloses a yellow spot; from here long gray streaks extend to tornus on inner margin and above submedian, the latter surmounted by a smaller spot, all of these gray spots and streaks being edged with crimson; a spot at end of cell and four spots beyond cell from veins 3–7; a series of postmedial spots between veins, their outer edge bluntly produced, the spot between veins 5 and 6, larger, with two projections; two subterminal spots below costa; small marginal spots, also produced outwardly, all the spots being steel gray edged with black and partly with crimson. Hind wings roseate with partly semihyaline gray streaks; costal margin whitish. Fore wings below with the spots crimson except the antemedial spots below cell; the two subterminal spots below costa black with crimson edges. Hind wings below lilacine rose, the round andraconia mark crimson.

Expanse.—38 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22413, U.S.N.M.

PAREVIA GURMA, new species.

Male.—Palpi and vertex cream color; frons gray edged behind with crimson; neck crimson. Collar, thorax, and fore wings purple. Abdomen above crimson, underneath white. Fore wings: spots and cilia creamy yellow separated from ground color by fuscous and crimson edging; a long spot at middle of costal margin, narrowing and rounded in cell, not quite reaching median vein; a small postmedial spot on costa; a larger apical spot on costa; a terminal spot

from below vein 5 narrowing to tornus. Hind wings rose color at base and on inner margin to near angle, the outer margin broadly black. Fore wings below dull fuscous gray, the spots without the black and crimson edging.

Expanse.—20 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 22414, U.S.N.M.

AUTOMOLIS ABDALSAN, new species.

Male.—Head: palpi black with broad orange stripes in front; frons metallic blue; vertex black edged with orange and with some blue scaling. Collar and thorax dark gray with orange stripes from head to tips of patagia. Abdomen black; dorsal and lateral blue spots; subdorsal orange patches at base barely separated dorsally; underneath black with orange ventral bands on two basal segments. Fore wings dull purplish, the cilia dull fuscous gray; veins ochreous; edge of costa orange; a broad orange streak from inner margin near base to termen on vein 6, not extending on cilia. Hind wings: the costal margin broadly orange, otherwise dull purplish. Underneath the costa of hind wings is a deeper orange.

Expanse.—36 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22415, U.S.N.M.

AUTOMOLIS GOLOMA, new species.

Male.—Palpi: First segment yellow, second and third yellow in front, fuscous behind; legs fuscous, the coxae and tarsi yellow. Head yellow; a blue and black streak across frons; a black spot with blue scales on vertex. Thorax and basal segments of abdomen yellow dorsally; terminal segments black with dorsal and subdorsal metallic blue spots; abdomen below yellow to near last two segments; lateral black and blue streaks. Wings yellow; fore wings with three terminal black spots between veins 2 and 5; these spots sometimes suffuse and expand to form a terminal black line; cilia olive gray in type, sometimes black; hind wings with terminal black shadings widest at anal angle, sometimes suffusing and forming a black border.

Expanse.—Male 37 mm; female 42 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22416, U.S.N.M.

AUTOMOLIS OBSCURATA, new species.

Female.—Palpi dull white; frons white; vertex yellow with crimson streaks. Collar and thorax gray with crimson streaks; shoulders gray. Abdomen crimson above. Body below and legs white, the fore tibiae tinged with yellow in front. Fore wings fuscous gray; crim-

son streaks on costa at base, on base of inner margin, antemedially on subcostal, in cell, on median, below cell and on submedian, the streak on median extending along vein 2 to termen; also some yellowish shading in cell; a small medial yellow spot on inner margin; veins 3 to 6 streaked with crimson; traces of crimson postmedial markings; from below cell and above vein 6 the costal margin is yellow; a small gray crimson edged spot postmedially between veins 6 and 7; termen above vein 2 irregularly yellow, narrowest between veins 4 and 6; a subterminal brown spot on vein 7; marginal brown spots on veins. Hind wings black. Fore wings below fuscous without any crimson markings, the base yellow, as well as the costa and termen. Hind wings below fuscous, the costal margin and cell yellow.

Expanse.—28 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22417, U.S.N.M.

AUTOMOLIS GYRATA, new species.

Male.—Head, thorax above and below, and legs black; fore coxae with blue scaling. Collar and shoulder yellow. Abdomen black above with three orange red segments beyond middle; two anal segments black shot with blue; underneath and laterally orange red, except anal segments. Wings black; a broad antemedial yellow fascia, slightly outbent; a narrower subapical yellow fascia expanding on costa and on outer margin. Hind wings: base yellow shaded with orange on inner margin.

Expanse.—43 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22418, U.S.N.M.

Differs from *A. tegyra* Druce in having the basal half of abdomen above black.

MELESE SOTREMA, new species.

Male.—Palpi reddish. Head, collar, and thorax brown mottled with reddish hairs; the patagia and thorax behind shaded with dark gray. Abdomen roseate, the terminal segments and venter brown; thorax underneath roseate. Fore wings reddish brown; a small semihyaline white spot between veins 5 and 6. Hind wings semihyaline white, the veins, margins and cilia roseate. Underneath the fore wing has an elongated black fovea below cell.

Female.—Is similar to the male.

Expanse.—Male, 37 mm.; female, 37–42 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 22419, U.S.N.M.

BERTHOLDIA FLAVILUCENS, new species.

Male.—Palpi crimson above, white below. Head mouse gray, the collar and thorax similar, finely irrorated with white, the tegulae and

the patagia dorsally edged with chrome yellow; crimson tufts laterally on thorax below patagia. Abdomen above crimson, the anal tufts and body underneath white; a lateral series of black spots. Fore wings lilacine irrorated with black, and tinged with roseate in cell and around semihyaline space; the costa crimson except on semihyaline space; cilia roseate tipped with white and shaded with fuscous on intervenal spaces, especially at tormus; a grayish streak irrorated with black above cell from base to middle of wing; the postmedial semihyaline space yellow with a few black points on veins, its outer edge slightly outcurved between veins 8 and 7, almost straight from 7 to 6, outbent and produced three times from 6 to 3, then parallel with 3 and slightly incurved to vein 5. A small antemedial chrome spot circled with black above submedian. Hind wings white, the inner margin broadly flushed with roseate.

Expanse.—Male 44 mm.; female, 55mm.

Habitat.—Volcan de Santa Maria; Purulha, Guatemala.

Type.—Cat. No. 22420, U.S.N.M.

HYPERTHAEMA ESCUINTLA, new species.

Female.—Palpi red, the third joint brownish. Head, collar, and thorax brown; some red at base of antennae. Abdomen above roseate, underneath flesh color; a sublateral row of black spots, and a lateral series of smaller spots. Fore wings reddish brown, the veins faintly redder; a fuscous antemedial point below cell, and a smaller fuscous postmedial spot between veins 5 and 6. Both very indistinct. Hind wigs black; some roseate hairs at base. Wings below dark brown with roseate hairs at base of wings.

Expanse.—38 mm.

Habitat.—Escuintla, Guatemala.

Type.—Cat. No. 22421, U.S.N.M.

HYPERTHAEMA SORORITA, new species.

Female.—Head, thorax and fore wings red brown, the veins slightly redder. Abdomen above crimson, underneath tinged with yellow; two lateral small black spots. Fore wings: a small black antemedial spot below cell with white center, and a smaller similar spot below it, the two sometimes suffusing; a white, black edged spot, beyond the cell; some roseate hairs at base of inner margin. Hind wings fuscous brown, the inner margin fringed with roseate hairs. Wings belc brown, the spots on fore wing white without black edging: An irregular basal white spot on hind wing and roseate hairs at base of both wings.

Expanse.—45 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 22422, U.S.N M. Very close to *H. haemacta*, Schaus from Costa Rica.

ELYSIUS GLADYSIA, ne

Male.—Palpi, head, and thorax crimson, the tegulae and thorax mottled with yellow; black points on tegulae, and also on patagia in front and behind; abdomen above reddish with narrow black segmental lines, the dorsum on basal half rosy red; underneath brown. Fore wings purplish brown crossed by numerous darker wavy lines; veins brown; margins and cilia finely fuscous gray; the markings yellow crossed by numerous wavy, irregular, crimson lines and edged with fuscous brown, the base forming a small irregular spot outbent on inner margin; a broad antemedial space oblique from costa to submedian vein, its edge below cell forming almost a complete ring; a large spot occupying end of cell; a broad postmedial space from costa to submedian, cut by veins, its outer black edging forming a very distinct line; a subterminal series of small spots, mostly round. Hind wings rosy red.

Expanse.—Male 60 mm.

Habitat.—Purulha, Guatemala.

Type.—Cat. No. 22423, U.S.N.M.

In the arrangement of the spots this species comes nearest *Elysius pyrosticta.* Hampson.

THALESA DEBILIS, new species.

Male.—Body and fore wings pale brownish yellow, whitish at base of abdomen dorsally; black points on tegulae; fore wings crossed by numerous wavy brown lines; antemedial line defined by grayish shadings, a medial line similarly shaded from subcostal vein to inner margin; a black point on discocellular; a small subterminal dark brown dash between veins 5 and 6, inner margin grayish brown. Hind wings yellowish white.

Expanse.—31 mm.

Habitat.—Cayuga, Guatemala, also in collection from Mexico and Costa Rica.

Type.—Cat. No. 22424, U.S.N.M.

Altogether paler than *T. citrina* Sepp and without the white spot on fore wing.

HALISIDOTA DEMOCRATA, new species.

Female.—Body above pale ochreous; a dark point on patagia in front. Wings whitish yellow. Fore wings: a few darker irrorations forming almost imperceptible markings; an antemedial wavy line outcurved in cell about its middle then inbent to submedian; some shading above and below end of cell; a small black point on discocellular at veins 4 and 5; a broken postmedial line and a wavy marginal line.

Expanse.—40 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22425, U.S.N.M.

HALISIDOTA MANCINA, new species.

Male.—Palpi laterally dark brown, fringed in front with ochre clay color. Head and collar grayish brown, with small dark dots on tegulae. Abdomen above brownish gray, underneath whitish. Fore wings clay brown with some fuscous irrorations and paler shading forming an irregular outcurved antemedial band; a postmedial series of spots incurved below cell, and subterminal dashes between the veins outwardly edged with black; a small yellow spot circled with black at end of cell. Hind wings dark brown, the costal margin broadly yellow white. Wings below yellowish white; forewings thinly irrorated with fuscous brown; a brownish shade in cell; an oblique row of dark spots from apex, followed below vein 5 by a parallel row. Hind wings with dark striae on costal and inner margins, and a terminal dark shade from below vein 2 to anal angle.

Expanse.—39 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22426, U.S.N.M.

Closely allied to *H. hadenoides* Rothschild.

HALISIDOTA PERDITA, new species.

Male.—Head: palpi whitish with a large lateral dark edged brownish spot on terminal half; front ochreous; vertex brown. Collar and thorax brownish ochre, the thorax paler behind. Abdomen dull brown above. Body underneath whitish. Fore wings dull yellowish with dark irrorations forming vague lines; a line from costa near base, well outbent and rounded below cell; a less distinct line outbent to vein 2 and connected with the first line above the submedian by rather thicker irrorations; a geminate, lunular, dentate postmedial line; a deeply angled subterminal line; the angle on inner side marked by black points; terminal black points on veins; a larger black point at end of cell, from which a faint dark line extends to apex. Hind wings with the space below cell and vein 2 to inner margin smoky gray.

Expanse.—42 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22427, U.S.N.M.

Near *H. pulverea* Schaus.

AGOROEA RULLA, new species.

Female.—Palpi with first segment yellow, otherwise black. Frons fuscous brown; vertex and neck orange; collar, thorax, basal half of abdomen dorsally and body underneath dark gray; terminal segments of abdomen above yellow with a black dorsal line. Wings

brownish gray tinged with lilacine, the disk of hind wings somewhat opalescent.

Expanse.—30 mm.

Habitat.—Purulha, Guatemala.

Type.—Cat. No. 22428, U.S.N.M.

AGOROEA SANTARIA, new species.

Male.—Palpi gray, the basal joint yellow. Frons dark brown; vertex, neck, throat and fore coxae yellow. Collar thorax and base of abdomen above gray brown, abdomen otherwise above yellow, with a dorsal black line; underneath dark gray. Fore wings gray brown, the veins faintly darker. Hind wings semihyaline whitish gray, slightly darker on margins.

Expanse.—35 mm.

Habitat.—Santa Maria, 5,500 feet, Guatemala.

Type.—Cat. No. 22429,U.S.N.M.

Nearest *A. schausi* Rothschild, but of a browner tint and the veins much less heavily marked; the hind wings also are more thinly scaled.

NERITOS ATTA, new species.

Male.—Palpi roseate; frons crimson; vertex yellow edged with crimson behind. Collar and thorax purple red. Abdomen above purple gray on basal segments, terminally rose color with roseate dorsal streak. Body underneath white. Fore wings: base from costa near middle to termen above tornus purple red shaded with roseate on inner margin; a crimson spot medially across submedian; outer space yellow with a large round apical spot of the basal color; the basal area and spot finely edged with crimson. Hind wings yellow tinged with roseate on costa, below cell, and more heavily so on inner margin. Fore wings below with the base and apical spot rose color. Hind wings below yellow, the long hairs on inner margin darker.

Expanse.—24 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22430, U.S.N.M.

AEMILIA CARMEN, new species.

Male.—Antenna: the shaft white, the pectinations yellow. Body dark olive gray, the thorax above mottled with white hairs. Fore wings whitish gray, thinly scaled almost semihyaline, whiter where scaling is thicker along costal and inner margins; an irregular basal fuscous line; an antemedial curved fuscous hand, broken in cell; a broad medial streak on costa, and a quadrate spot on inner margin; postmedial spots on costal and inner margins, and short fine streaks on veins; the median vein from middle, also discocellular vein, and base of vein 2 blackish brown; a brownish marginal shade, mottled

with gray; the tips of veins darker. Hind wings semihyaline grayish white, somewhat darker at apex and on inner margin.

Expanse.—35 mm.

Habitat.—Purulha, Guatemala.

Type.—Cat. No. 22431, U.S.N.M.

PARANERITA IRMA, new species.

Male.—Palpi yellow rose in front, crimson laterally. Frons purple brown; vertex bright yellow, edged in front and behind with crimson. Collar and thorax purple brown; a large crimson spot in center of thorax. Abdomen above deep crimson; a small black dorsal spot at base, and one on anal segment; anal hairs yellow; underneath pale yellow. Fore wings deep purple; a crimson streak on basal third of inner margin; a round antemedial spot below cell; a small medial spot on inner margin and postmedial spots above and below submedian, all crimson with a few central yellow scales; costal and marginal costal spot yellow with crimson edges; a large medial costal spot to median, its hind edge rounded; a small postmedial costal spot its hind edge straight; a larger spot near apex; the terminal spot wide and straight on vein 5, only a little downbent on termen, narrowing to a point at tornus; cilia on termen yellow mottled with crimson toward apex. Hind wings yellow with some crimson hairs; termen black. Fore wings below fuscous; spots as above; inner margin yellow to near tornus.

Expanse.—23 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22432, U.S.N.M.

Family AGARISTIDAE.

ALYPIA AUSTRALIS, new species.

Male.—Body black; some fine white scaling on neck; a white spot on shoulders. Fore wings fuscous brown; a cream color space from base to middle of wing, its anterior edge barely entering cell at base, then expanding to near subcostal, curved down across median and base of vein 2, the lower edge from just below submedian at base, then upcurved toward cell; a subterminal cream color spot from vein 2 to vein 8, cut by veins mostly finely black, vein 5 being more heavily marked. Hind wings orange yellow, the termen broadly black, especially from vein 2 to inner margin; a black discocellular streak. Wings below similar; vein 5 on fore wing not more heavily marked.

Expense.—31 mm.

Habitat.—La Farga, Argentina.

Type.—Cat. No. 22433, U.S.N.M.

I am indebted to Don Pedro Jorgensen for this interesting species.

Family LYMANTRIADAE.

ELORIA VELHOA, new species.

Female.—Head: palpi and frons whitish; vertex yellowish; antenna with the shaft gray, the pectinations brown. Thorax and abdomen white. Wings white, semihyaline, the veins clearer white. Fore wings: costa grayish brown; terminal space with smoky brown streaks on interspaces, the longest between veins 2 and 3, and 5 and 6, the shortest streak between veins 3 and 4, and above tornus.

Expanse.—56 mm.

Habitat.—Porto Velho, Rio Madeira, Brazil.

Type.—Cat. No. 22434, U.S.N.M.

TROCHUDA ERRANS, new species.

Male.—Palpi, head, and body white; pectinations of antennae ochreous; a brownish shade on patagia in front and some brownish tipped dorsal tufts on abdomen. Fore wings: the cell to beyond middle and terminal space yellow ocher, the end of cell and just beyond bister brown, this shade extending as a wavy line toward base of inner margin; postmedial space shaded with lilacine, and defining a very wavy yellowish ocher shade from apex to middle of inner margin; costa white irrorated with gray; basal half of inner margin white, veins mostly white especially from cell to near termen, the discocellular more heavily white and with a white line projecting in cell and followed by a white spot; white spots on cilia at veins. Hind wings white. Wings underneath white.

Expanse.—30 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22435, U.S.N.M.

TROCHUDA VOTIS, new species.

Male.—Head white; palpi white, laterally black; shaft of antennae white, the pectinations light brown. Collar and thorax white. Abdomen ochreous white. Fore wings pale ochreous; costa whitish; a white line on discocellular shortly outbent between veins 4 and 5; cilia paler. Hind wings white. Wings underneath white.

Expanse.—32 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 22436, U.S.N.M.

TROCHUDA UNICOLOR, new species.

Male.—Body and wings dull dark grayish brown; pectination of antennae pale brown. A minute whitish streak on discocellular of fore wing. Wings below dark silky gray.

Female.—Dark gray, the veins finely brown; a vague darker shade where veins 4, 5, 6, and 7 meet discocellular.

Expanse.—Male 29 mm. Female 47 mm.

Habitat.—Castro, Parana.

Type.—Cat. No. 22437, U.S.N.M.

Nearest *Trochuda* (*Carama*) *modificata* Druce.

PERNAMBIS, new genus.

Female.—Antennae flattened, minutely serrate. Palpi upturned, slender, not reaching vertex. Abdomen short, the anal segment with thick tufts of hair. Wings long and narrow. Fore wings: cell long and narrow; veins 2, 3, 4 equally apart; 5 close to 4 or from a point; 6 and 7 from a point near upper angle; 8 and 9 on long stalk from upper angle; 10 and 11 from cell. Hind wings: Vein 2 well before end of cell; 3 and 4 from a point at end of cell; 5 below middle of discocellular; 6 from below upper angle of cell; a small areole in cell at middle of discocellular; 7 from upper angle of cell.

Type of genus.—*Pernambis intervenata*, new species.

PERNAMBIS INTERVENATA, new species.

Female.—Body brown. Fore wings white with brown streaks on all interspaces. Hind wings brown, the veins on terminal half streaked with white.

Expanse.—33 mm.

Habitat.—Pernambuco, Brazil.

Type.—Cat. No. 22438.

ORGYIA GUATEMALTECA, new species.

Male.—Palpi pale brown; antennae with the shaft pale brown, the pectinations fuscous. Head and thorax bone color, the patagia tipped with fuscous. Abdomen pale brown. Fore wings bright brown; a basal and a medial black brown line, the former slightly outbent, the latter nearly straight; a white lunule at end of cell filled in with bright brown and followed by a black shade which coalesces with the postmedial line, the latter being black brown, fine, lunular, incurved below cell, and is followed by clusters of dark brown scales on interspaces forming streaks toward costa; some marginal brown shading. Hind wings dull fuscous brown, the cilia pale. Wings below ochreous brown, the disk of fore wing tinged with black; a black post-medial shade and subterminal spots; the hind wing with a postmedial dark line.

Expanse.—26 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22439, U.S.N.M.

ROLEPA CASTRONA, new species.

Female.—Body rosy brown, the palpi darker; shaft of antennae ochreous. Wings silky rosy brown. Fore wings: an antemedial,

geminate darker line, oblique from costa, downbent below vein 2, the lines meeting on inner margin; a small dark oblique line at end of cell; postmedial dark line finely wavy, angled beyond cell, followed by a more heavily marked line, parallel to it, but straight and outwardly pale edged; marginal indistinct dark shadings; a dark brown line from close above vein 6 to apex, inwardly pale edged. Hind wings with only the outer lines as on fore wing. Wings below similar, the markings less distinct and no antemedial lines on fore wing.

Expanse.—41 mm.

Habitat.—Castro, Parana, Brazil.

Type.—Cat. No. 22440, U.S.N.M.

ROLEPA NIGROSTRIGA, new species.

Female.—Head, palpi, and frons light brown; vertex pale gray; shaft of antennae pale gray, the pectinations black. Thorax and abdomen gray, the collar rosy brown. Wings gray. Fore wings: antemedial and postmedial geminate brownish lines filled in with darker gray, the antemedial wavily oblique from costa, downbent below cell, the postmedial oblique and straight from costa, angled and slightly inbent from below vein 6; an irregular brownish marginal shade and a chestnut brown streak from close above vein 6 to apex; an oblique fine brown black streak at end of cell. Hind wings: the lines as on fore wing, but slightly curved. Wings below paler, tinged with brown; a faint postmedial dark line followed by a white line, angled between veins 5 and 6 on forewing; outer margins rosy brown.

Expanse.—42 mm.

Habitat.—Venadio, Sinaloa, Mexico.

Type.—Cat. No. 22441, U.S.N.M.

CORYPHYALA JOHANNA, new species.

Female.—Body and wings pale ocher. Wings: termen beyond outer lines shaded with brown; fine outer and subterminal fuscous lines, parallel and deeply lunular. Fore wings: base to close to end of cell shaded with brown, limited by a partly lunular and partly wavy fuscous line which is preceded by a similar line, well marked from costa to median then faint to inner margin; discocellular crossed by a very oblique thick brownish black line. Hind wings: a dark line on discocellular, perpendicular to costal margin. Wings below pale brownish ocher, the terminal space brown; the lines more heavily marked; the subterminal line outwardly pale shaded; the discocellular lines very faint.

Expanse.—75 mm.

Habitat.—St. Jean, French Guiana.

Type.—Cat. No. 22442, U.S.N.M.

Near *Coryphyala orbigera* Herrich-Schäffer.

STAETHORINIA CAYUGANA, new species.

Male.—Head: palpi brown tipped with fuscous in part; frons brown; vertex ochreous; antennae with the shaft ochreous, the pectinations black. Collar, and thorax ochreous. Abdomen yellow. Fore wings ochreous brown, the costa finely yellow; lines fine and lightly marked; antemedial line slightly inbent from costa to inner margin; postmedial line very slightly sinuous followed by a still fainter parallel line; small subterminal black spots on interspaces in part shaded with a few white scales; a white line on discocellular and a white point at origin of vein 4. Hind wings yellow. Fore wings below yellow, the costa and apex darker yellow; termen finely purplish brown expanding to vein 7; two postmedial dark streaks on costa. Hind wings below deep yellow; a small fuscous brown spot on discocellular; three purplish lines on outer half of wing, the first beyond cell wavy and not extending below vein 4, the second lunular not reaching inner margin, the third macular; the termen narrowly and cilia purplish brown.

Expanse.—40 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22443, U.S.N.M.

Family CERATOCAMPIDAE.

CITHERONIA MOGYA, new species.

Male.—Head, collar, and thorax above brownish red; yellow spots on vertex, and a yellow line behind collar. Abdomen above brownish red with pale yellow segmental lines, almost completely hidden, underneath yellow with lateral and sublateral dark red spots. Fore wings dark steel gray; a small basal yellow spot on costa, and a larger one in cell, the latter preceded by a brownish red streak to inner margin; a round reddish spot in cell before end and reddish streak on discocellular; also a few reddish markings beyond cell; a small red spot below vein 2 near cell; postmedial elongated spots in an oblique line from costa to near middle of inner margin, these spots yellow, mostly completely overlaid with dark red, and followed by an interrupted, and irregular red line. Hind wings yellow shaded with dark red, forming a broad outer line, and spot below cell, the cell and subterminal space remaining yellow; a red spot on discocellular. Fore wings below reddish, the cell and postmedial spots yellow; a brownish red quadrate spot at end of cell; inner margin yellow. Hind wings below yellow, the veins finely dark red; a red spot on discocellular; costa and outer margin broadly tinged with lilacine.

Expanse.—104 mm.

Habitat.—Serra do Mogy, Sao Paulo, Brazil.

Type.—Cat. No. 22444, U.S.N.M.

I am indebted to Mr. May for this species which is somewhat like *C. hamifera fuscalis* Rothschild but the wings are longer, narrower, and of a different color; the postmedial spots are also quite different.

EACLES MAYI, new species.

Male.—Head, collar, thorax, and abdomen yellow, the patagia, some dorsal basal spots and broad transverse bands on abdomen above brownish red. Fore wings yellow, thickly overlaid with brownish red from base to just beyond end of cell, inclosing two slightly darker spots at discocellular; some fuscous striae chiefly on postmedial yellow space; a broad purplish line from apex to inner margin at two-thirds from base; the termen beyond this line strongly shaded with lilacine, only a little yellow showing towards inner margin next to line. Hind wings bright yellow to outer line; a round discal spot, brownish red containing a few lilacine scales; a large brownish red spot on inner margin from beyond base to middle of wing; a dark purplish outer line, beyond which the terminal space is brownish red, shaded with purple and with a few dark striae; also some yellow at apex and on inner margin near line. Wings below cream color with some darker striae, the lines faintly lunular; the termen partly shaded with purple; the discal spots purple with lilacine scaling; the base and disk of forewing tinged with canary yellow.

Expanse.—97 mm.

Habitat.—Rio de Janerio, Brazil.

Type.—Cat. 22445, U.S.N.M.

I take pleasure in naming this species after Mr. May of Rio de Janeiro to whom I am indebted for specimens. This species is allied to *Eacles masoni* Schaus.

ADELOCEPHALA JACCA, new species.

Male.—Body above light brown, the thorax tinged with lilacine; underneath lilacine; fore wings brown faintly tinged with lilacine at base, more heavily so on termen; a fine dark line from apex to beyond middle of inner margin; a silvery white spot on discocellular behind, and a white streak above it. Hind wings red, the termen brown. Fore wings below red, the costa and apical space brown within line, the latter not extending below vein 3; termen lilacine; a large black discal spot, containing a pale point at origin of vein 2. Hind wings below white tinged with lilacine.

Expanse.—85 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22446, U.S.N.M.

Near *A. pollens* Schaus, but broader winged.

ADELOCEPHALA APPROXIMANS, new species.

Male.—Body above purplish except thorax and base of abdomen, which are ochreous yellow; underneath white tinged with lilacine.

Fore wings lilacine with some fuscous striae; costal margin to median and almost to apex brown; the inner margin purplish; a white point edged with purple at end of cell. Hind wings purplish red. Fore wings below purplish red, the outer margin lilacine. Hind wings below white.

Expanse. 70 mm.

Habitat.—Joinville, Southeast Brazil.

Type.—Cat. No. 22447, U.S.N.M.

Evidently closely allied to *A. vinacea* Rothschild.

I am indebted to Mr. J. Arp, of Rio de Janeiro, for a specimen of this species.

ADELOCEPHALA SINALOANA, new species.

Male.—Body above yellow, the patagia shaded with purple; underneath lilacine, the legs dark gray. Fore wings in type: base and termen purple; space between lines except inner margin yellow with purplish striae, the inner line slightly sinuous; outer line straight from costa near apex to middle of inner margin. Hind wings crimson, the termen yellow. Fore wings below crimson from base to near apex; a yellow space on costa within line; termen lilacine shaded with red toward inner margin; a large black spot with white center at end of cell. Hind wings below whitish strongly tinged with lilacine on costal half; a line from near apex not reaching inner margin.

Expanse.—54 mm.

Habitat.—Sinaloa, Mexico.

Type.—Cat. No. 22448, U.S.N.M.

A very variable species. Sometimes the fore wing is yellow thickly covered with purple striae, or dark gray with the medial space brown.

ADELOCEPHALA ROSEILINEA, new species.

Male.—Body and wings white; legs roseate. Fore wings: base shaded with roseate; two roseate lines, the first from costa across discocellular then inbent, the outer line from costa near apex to inner margin beyond middle. Hind wings with a fine and faint outer roseate line.

Expanse.—43 mm.

Habitat.—Guapiles, Costa Rica.

Type.—Cat. No. 22449, U.S.N.M.

Family HYPSIDAE.

EUCYANE ESCUINTLA, new species.

Male.—Palpi black; head, collar, and thorax black streaked with blue, the sides of frons white. Abdomen above black shot with blue and with brighter blue fine segmental lines, underneath red with black segmental lines. Legs black streaked with white. Fore wings

brown black; cilia at apex and tornus white; a narrow postmedial white band from costa, slightly curved to outer margin at tornus. Hind wings black shot with dark blue; cilia white. Underneath: fore wings black streaked with blue below costa and cell, the postmedial white line as above; hind wings black shot with blue on basal half; a very small red spot on costa postmedially, followed by a series of minute white spots, straight to below vein 3 then inbent.

Expanse.—60 mm.

Habitat.—Escuintla, Guatemala.

Type.—Cat. No. 22450, U.S.N.M.

Allied to *E. pylotis*, Drury; but the white line much narrower; underneath the markings have a tendency toward *E. excellens* Walker.

Family EUPTERОTIDAE.

APATELODES SUBLUNULATA, new species.

Male.—Palpi pale brown; frons light brownish gray; antennae, vertex, tegulae and patagia whitish gray with scattered black irrorations; thorax pale brown; abdomen light brownish gray with dark irrorations basally and terminally; abdomen below with fuscous segmental lines and irrorations. Fore wings whitish gray with black irrorations and light brownish shadings; the basal shadings restricted by a whitish shade from costa oblique to median, inangled, perpendicular to submedian and more clearly white, then inbent, throughout shaded outwardly with fuscous; a medial wavy fuscous line; the space between these lines and beyond medial line brown shaded; a whitish spot at end of cell; postmedial line slightly wavy, oblique on costa, slightly incurved below cell, followed by a parallel and more distinct crenulate line, both lines partly shaded outwardly with light brown; a subterminal white shade narrow on costa broader and somewhat crenulate from vein 3 to inner margin, indistinct opposite cell where it is followed by a dark spot; termen and cilia brown shaded; a fine terminal black line and fuscous shadings on cilia especially at apex. Hind wings whitish ocher; a brown line on discocellular; a geminate fine outer line defining a clearer white shade, and surmounted on inner margin by a brown shade defined by fuscous; some scattered dark scales on terminal space and cilia; the cilia dark shaded at anal angle. Fore wings below pale brown, darkest just beyond cell; costal margin white with some dark irrorations; inner margin whitish; a small white spot at end of cell; postmedial line curved around end of cell, fine, dark, followed by a fine crenulate line; a subapical fine whitish streak; veins terminally, a terminal line and cilia mostly fuscous brown, the latter with pale spots. Hind wings below mostly light brown shaded with fuscous brown in and beyond cell; a narrow whitish spot at end of cell; costa and inner margin medially from below

cell whitish with dark irrorations. First line beyond cell, thick, dark, outangled and suffusing with the dark shadings; second line fine, black outwardly edged with whitish, somewhat incurved from costa to vein 5, then crenulate to inner margin; a terminal dark line; cilia with pale spots.

Expanse.—45 mm.

Habitat.—Venadio, Sinaloa, Mexico.

Type.—Cat. No. 22451, U.S.N.M.

APATELODES HORINA, new species.

Male.—Body and wings dark gray. Palpi brown black; a similar streak from vertex between tegulae, and a transverse line across patagia. Thorax behind brown black; dorsal anal hairs dark. Fore wings: lines fine, dark brown; antemedial line faint, oblique from costa to vein 2 almost touching medial, then inbent and perpendicular, preceded on inner margin by a large quadrate velvety brown black spot divided by a longitudinal gray line; medial line geminate, faintly wavy; postmedial sinuous, outbent, geminate, the inner line more heavily marked; a well marked subterminal line more sinuous than postmedial from costa at three-fourths from base to tornus; outer margin more darkly shaded; a white point between veins 6 and 7. Hind wings dark silky gray; a medial darker fascia, terminating on inner margin in a black spot edged with white above and and below. Fore wings below silky gray, the costa whitish; a sinuous postmedial line; a subterminal white line, slightly curved on costal margin then straight to tornus; the white point below vein 7 surmounted by whitish irrorations forming a line to costa. Hind wings below silky gray, the costal and inner margins white except on medial dark fascia; a postmedial white line evenly outcurved and rounded to inner margin.

Expanse.—45 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 22452 U.S.N.M.

Near *A. turrialba* Schaus.

OLCECLOSTERA BRAMA, new species.

Male.—Head and thorax dark brown, finely irrorated with pale buff. Abdomen brown. Fore wings brown shaded with fuscous purple, darkest on basal third; a wavy irregularly edged antemedial fascia still darker; a small black pale edged spot on discocellular; postmedial line fine, fuscous, incurved below cell, outcurved below vein 2, followed on costal and inner margins by a fuscous spot; an outer fine, indistinct line, lunular and punctiform on veins; traces of a subterminal lunular line preceded between veins 5 and 6 by a semihyaline yellowish white spot, indentate on its outer edge; below

vein 5 a very small black spot. Hind wings dark brown; an outer faint, fuscous, postmedial line, and a similar outer line, outwardly pale edged. Wings below light ochreous brown; black points on discocellular; fine postmedial darker brown lines, the outer line fine fuscous, minutely lunular on hind wings.

Expanse.—42 mm.

Habitat.—Departamento de Antioquia, Colombia.

Type.—Cat. No. 22453, U.S.N.M.

Presented by the American Museum of Natural History, New York City.

OLCECLOSTERA QUADRILINEATA, new species.

Male.—Body pale lilacine buff irrorated with brown, chiefly on collar and thorax; a dorsal brown line on collar and thorax; palpi dark brown behind. Fore wings pale lilacine buff, crossed by four brown lines; the costa finely dark brown; antemedial line from subcostal inbent to inner margin; medial line from costa parallel; postmedial slightly more remote on inner margin than on costa; fourth line from termen at vein 7 to vein 2 subterminally, this line forms a faint lunule between veins 6 and 7, but is otherwise straight. Hind wings whitish broadly shaded on margins with pale lilacine buff; a straight buff medial line; postmedial defined by marginal shading; subterminal small dark shades between veins 3 and 6. Wings below whitish with faint pale lilacine shading; lines faintly marked; antemedial on fore wing absent.

Habitat.—Rio Madeira, Brazil.

Type.—Cat. No. 22454, U.S.N.M.

Allied to *O. Tanais* Druce.

CARTHARA DEMERIDA, new species.

Male.—Head: frons rufous shading to white on vertex; shaft of antennae white, the pectinations brown streaked with white close to shaft. Collar dark rufous. Thorax pale rufous brown mottled with white hairs. Abdomen pale rufous, with small dark brown subdorsal spots on basal segments. Fore wings light ochre buff, with rufous irrorations; a white streak on costa at base, followed by antemedial and medial dark reddish brown streaks separated by white scaling, and a smaller dark spot postmedially; lines very fine, darker, almost imperceptible, the antemedial geminate, slightly outcurved across cell, the postmedial, geminate, wavily lunular; a fine dark streak across discocellular, cilia dark brown. Hind wings pale rufous, dark streaks on inner margin; dark rufous shading at anal angle. Fore wings below rufous darkest at apex, the inner margin yellow; costa yellowish, the dark spots very small; some whitish shading at middle of outer margin. Hind wings below rufous, the costa shaded with dark gray; a black streak on discocel-

lular; a lunular, geminate postmedial fine black line terminating at a dark streak before inner margin which extends to termen; a small white spot on outer edge of the line adjoining the dark streak.

Female.—Body and wings yellowish buff. Fore wings: the lines more distinct filled in with a slightly darker shade, the postmedial marked with minute rufous spots on costa; some whitish shading at middle of outer margin. Hind wings slightly tinged with rufous; an antemedial rufous spot on inner margin; a postmedial geminate line as on fore wing, but less lunular. Wings below yellowish buff, the hind wings with a geminate postmedial dark line, outcurved, the two lines almost meeting on inner margin where they are shaded with lilacine white; a dark shade on termen at anal angle.

Expanse.—Male, 32 mm.; female, 40 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 22455, U.S.N.M.

CARTHARA ALTURA, new species.

Male.—Palpi and frons brown, shading to whitish gray on vertex; antennae with the shaft whitish gray, the pectinations brown. Collar dark sienna brown. Thorax whitish gray. Abdomen shaded with dark gray, the base dorsally brownish yellow. Fore wings light gray, the basal third shaded with brownish yellow; antemedial line fine, dark, geminate, slightly outcurved, starting from dark points on costa; a very fine dark line on discocellular; a fine postmedial, lunular, line marked by a small dark spot on costa and followed by another similar line parallel to it from vein 4 to inner margin; above vein 4 this second line is white broadly edged outwardly with sienna brown, and there is a large similar patch on its inner side between veins 4 and 6; veins 2, 3, and 4 are yellow from postmedial line to termen, vein 5 yellow only on termen, vein 6 from cell and vein 7 from second line to termen. Hind wings rufous yellow; a fine geminate dark postmedial line slightly lunular, outwardly edged with white towards the darker shade on inner margin; alternate white and dark gray lines on inner margin; veins on termen yellowish. Fore wings below shaded with brown on outer half, the inner margin yellow; faint traces of the postmedial lines. Hind wings below dark yellow mottled with rufous scaling; a fine dark line on discocellular; the postmedial dark lines well marked; a dark streak between the two lines before inner margin, the outer line also edged with white outwardly towards inner margin.

Female.—Frons and collar brown, the vertex white. Thorax brownish gray. Abdomen above brownish gray with a dorsal fuscous line. Fore wings: The base brownish gray limited by the outer of the antemedial geminate line, which is darker brown, irregularly outbent to median, then wavily down bent to inner margin; medial

space dull gray with a fine dark line on discocellular; first postmedial line dark, outbent from costa to vein 4, then angled and lunular to inner margin, the space to second line grayish brown; the second line whitish, lunular to vein 4, then parallel to first line followed from costa to vein 4 by a reddish brown shade wide on costa. Hind wings light brown; smoky gray streaks between veins 4 to 6 from cell to termen, marginal streaks on other interspaces; faint traces of an outer lunular line; base of inner margin with white hairs, outer half fuscous gray, with a red brown streak along the edge interrupted by a small white spot. Fore wings below dull dark smoky gray, the veins yellow; inner margin yellow; a light brown costal spot before apex; a whitish shade at middle of outer margin. Hind wings below yellowish buff irrorated with brown; the postmedial line heavily m rked; the outer line finer, and lunular towards inner margin, a gray streak before inner margin from base expanding at termen.

Expanse.—Male, 33 mm.; female, 43 mm.

Habitat.—Volcan de Santa Maıia, Guatemala.

Tpye.—Cat. No. 22456, U.S.N.M.

CARTHARA PURULHANA, new species.

Female.—Palpi reddish; frons purple brown. Collar reddish brown. Thorax and abdomen above dark slate mottled with white hairs. Body below pale reddish brown. Fore wings dark slate color, the veins, costa, and inner margin finely reddish brown; base of inner margin yellowish; a fine fuscous streak on discocellular followed by a greenish yellow shade between veins 4 and 6; the geminate antemedial line hardly visible; a fine postmedial dark line outcurved around the yellow postdiscal shade, geminate and hardly visible below vein 4; the outer portion of line reddish brown from vein 4 to costa edged on either side with greenish yellow; cilia purple brown, shaded with black toward apex. Hind wings slate color. The veins, cell, and interspaces near cell between veins 2 and 4 pale reddish; a dark gray streak from base to termen below cell and vein 2; a dark red brown streak along inner margin with the cilia mottled black and white; cilia on termen black tipped with yellow. Hind wings below purple brown; a yellowish medial shade; a yellow streak below cell and vein 2; first outer line almost medial, dark, well defined, the second line fine and indistinct; a dark red brown shade at anal angle.

Expanse.—43 mm.

Habitat.—Purulha, Guatemala.

Type.—Cat. No. 22457, U.S.N.M.

CARTHARA TREMULANS, new species.

Male.—Head and thorax buff. Collar and addomen light reddish brown. Fore wings reddish brown mottled with yellow scales, ex-

cept on base; first antemedial line inwardly edged with yellow, the second line darker, ill defined; postmedial line darker outcurved on costa, wavy below vein 4; a subterminal yellow line, almost straight to vein 4; then slightly lunular to tornus its inner edge faintly dark shaded; termen shaded with gray from apex to just below vein 3. Hind wings pale reddish; the outer line fuscous, finely wavy, outwardly edged with yellow; a faint yellow shade at end of cell; a dark reddish brown shade at anal angle; hairs on inner margin yellow spotted with brown. Fore wings below red, the apex broadly shaded with fuscous gray, crossed by a subapical whitish line, the inner margin yellow. Hind wings below red shaded and irrorated with yellow; postmedial line reddish; outer line fuscous, outwardly edged with yellow becoming white near inner margin and there crossing a dark shade from anal angle to postmedial line; a fine red streak on discocellular.

Expanse.—28 mm.

Habitat.—Jalapa, Mexico.

Type.—Cat. No. 22458, U.S.N.M.

CARTHARA GRANISCA, new species.

Female.—Head: frons dark purple; vertex brown mottled with white hairs; palpi brown tipped with yellow. Thorax light reddish brown, the tegulae and patagia dark purple with some white hairs. Abdomen above reddish brown, underneath paler. Forewings purplish brown; base mottled with olive yellow, except a round purple spot; first antemedial line fuscous, outcurved to vein 2, slightly incurved below it; second line less curved, and not so distinct; medial space narrow, paler, but broadened beyond cell; two black points on discocellular; postmedial line outbent to vein 4, then inbent along this vein to lower discocellular point below which the line is almost straight to inner margin; outer line remote on costa, somewhat lunular and slightly oblique to vein 4 then deeply lunular to inner margin outwardly finely edged with whitish, especially on costa; termen broadly lilacine from vein 4 to costa leaving a brown shade beyond the outer line. Hind wings brownish red; postmedial line fine, black, hardly visible; outer line indistinct, but thickening to black shades between veins 4 and 6 and below vein 2 to postmedial; a distinct white line outwardly runs along this last black shade and is upbent to inner margin at postmedial line. Forewings below dull purplish, the termen shaded with red, the inner margin pale reddish. Hind wings below dark brownish red; a black line on discocellular; postmedial fuscous surmounted by white scaling on a dark streak below vein 2; postmedial line fuscous, with some white scaling between veins 4 and 6, and a distinct white line from vein 2 to inner margin; some white irrorations at anal angle.

Expanse.—55 mm.
Habitat.—Purulha, Guatemala.
Type.—Cat. No. 22459, U.S.N.M.

CARTHARA LAPANA, new species.

Male.—Head and palpi brown. Collar and tips of patagia dark brown, thorax otherwise grayish buff. Abdomen yellow-brown. Forewings roseate gray, the inner margin broadly tinged with yellow, the lines fine, brownish, geminate with small brown spots on costa; the antemedial wavy, outbent on costa; the postmedial lunular, a dark olive brown quadrate spot between the lines from vein 4 to 6 the upper part of outer line from vein 4 white terminating in a small white costal spot, and is outwardly edged with reddish brown widest on costa, and also forming a small spot close above vein 4; cilia dark shaded except at vein 4; a fine dark streak on discocellular. Hind wings yellow; a rosy brown shade from cell to termen between veins 4 and 6, with similar marginal shades on interspaces; the outer line only visible, fine, dark gray; a grayish shade below cell and vein 2; reddish brown lines on inner margin. Forewings below pale reddish becoming darker at apex; the costa narrowly, the inner margin broadly yellow; white irrorations at middle of outer margin. Hind wings below yellowish thickly mottled with reddish hairs; a dark streak on discocellular; the postmedial line reddish, outcurved; the outer line fine, fuscous, straighter, edged with a white line where crossing the gray shade below vein 2; inner margin with yellowish hairs.

Female.—Body and forewings pale brownish buff faintly tinged with lilacine. Collar pale reddish brown. Forewings: the lines pale reddish brown; antemedial geminate, outbent across cell, wavy, touching first postmedial line at vein 2; a very fine streak on discocellular; the first postmedial outbent to vein 4, then inbent lunular; the outer line remote on costa, outwardly finely pale edged and followed by a pale brown shade from vein 4 to costa where it is widest; cilia shaded with dark brown except at vein 4. Hind wings pale reddish brown, the veins finely yellowish, the outer lines very indistinct. Wings below pale reddish brown, the lines on hind wing distinct the outer line outwardly edged with yellow.

Expanse.—Male, 32 mm.; female, 42 mm.
Habitat.—Jalapa, Coatepec, Mexico.
Type.—Cat. No. 22460, U.S.N.M.

TAMPHANA MAOMA, new species.

Male.—Palpi dark brown. Antennae light brown. Head, collar, and thorax lilacine brown; a fuscous dorsal line on collar and thorax. Abdomen dull brown. Forewings brown faintly tinged with lilacine and with a few scattered black scales; an antemedial, inbent, fuscous

shade; a white point on discocellular; a fine geminate, lunular, postmedial line, indistinct and scarcely darker than ground color; small subterminal semihyaline black spots between veins 4 and 7. Hind wings brown; inner margin white with white cilia; the produced anal angle darker shaded. Wings below bone color shaded with brown terminally. Forewings: the postmedial lines straighter, brown; the subterminal spots as above. Hind wings: some scattered black points; a black spot on discocellular; two brown outer lines, lunular, dentate.

Expanse.—30 mm.

Habitat.—St. Jean, French Guiana.

Type.—Cat. No. 22461, U.S.N.M.

EPIA PICTA, new species.

Male.—Body rufous; palpi in front yellow on second joint; antennae light brown, the shaft irrorated with white; collar mottled behind with white hairs; a few white irrorations on patagia. Forewings: base of costa rufous, below it a lilacine shade mottled with brown; basal half of inner margin light brown; a yellowish streak below cell and vein 2 to near termen cut by the rufous lines; a rufous streak below this broadening to inner margin on outer half; a dark brown shade in cell antemedially, extending as a dull gray shade between veins 2 and 3 to termen; above this in cell and between veins 3 and 4 a lilacine gray shade suffusing with a similar broad outer shade from costa, leaving a triangular brownish shade on costa within the postmedial line; antemedial line outcurved, wavy dark red; a dark medial line below vein 2; postmedial slightly lunular, dark red from veins 5 to 7, and below vein 2 fine, grayish and hardly perceptible on the pale portion of wing; a fine deeply lunular outer dark gray line; some subterminal rufous spots, and a small white spot between veins 2 and 3; termen shaded with dark gray from below vein 6; the tornus rufous. Hind wings rufous brown, becoming dark red at anal angle; the two outer lines fine, fuscous, separated by a yellow shade near inner margin; inner margin fuscous brown with white irrorations. Forewings below pale reddish, the inner margin broadly yellowish white; the costa ochreous yellow; postmedial line straight, fuscous brown and thick, from costa to vein 4; outer line finer, lunulate; apex yellow; termen dark rufous. Hind wings below purplish, the base and costal margin rufous; postmedial line almost straight, the outer line finer, lunular.

Female.—Body and wings paler rufous; abdomen with darker subdorsal lines. Fore wings: a grayish purple shade between veins 2 and 4 from cell to termen; white irrorations on costal margin and broadly at apex; costa ochreous yellow; a faint fuscous postmedial line, finely lunular and hardly inbent. Hind wings: anal angle

broadly dark red; fuscous lines only visible near inner margin; whitish shadings medially on inner margin. Fore wings below dark gray, becoming brownish yellow at apex and terminally; the costa dark ochreous yellow; traces of a fine dark postmedial line; outer line fine, lunular, well defined to near inner margin. Hind wings below dark brown, the basal half shading to light brown terminally, the disk heavily irrorated with white; postmedial line very faint; outer line, fine, lunular, well defined.

Expanse.—Male, 45 mm.; female, 60 mm.

Habitat.—Antioquia, Colombia, at an elevation of 5,000 feet.

Type.—Cat. No. 22462, U.S.N.M.

Received from the American Museum of Natural History, New York City.

EPIA MADEIRA, new species.

Male.—Head reddish brown; palpi in front buff. Thorax lilacine brown. Abdomen reddish brown. Fore wings chiefly gray, the inner margin below vein 2 pale reddish brown; costa reddish brown streaked with white; a yellowish white space at base limited by a reddish brown line, from costa at base to vein 2 near cell, sharply angled and inbent to submedian; basal third of inner margin below submedian yellow; geminate medial and postmedial fine lines from vein 2 to inner margin; a black line on discocellular followed by a similar oblique streak to costa, edged anteriorly by an olive buff shade, a fine dark outer dentate line being part of the geminate postmedial line; faint subapical yellowish shading; a subterminal white spot between veins 3 and 4, and a similar point below vein 3. Hind wings pale reddish forming a darker subterminal shade, which is more pronounced and reaches termen from vein 2 to inner margin; a fine fuscous outer line shaded on either side with yellow. Fore wings below pale roseate buff, the costa and space above vein 4 reddish brown, crossed by a short black streak on discocellular; a postmedial inbent black line and a lunular outer line; the subterminal white spots as above. Hind wings below roseate, the costal margin reddish brown; the postmedial and outer lines faint; a dark streak below cell and vein 2 from base to postmedial line.

Expanse.—38 mm.

Habitat.—Rio Madeira, Brazil.

Type.—Cat. No. 22463, U.S.N.M.

Near *E. vulnerata* Felder.

EPIA LUNILINEA, new species.

Male.—Head: palpi brown; frons whitish buff; some brown hairs at base of antennae; shaft of antennae white, the pectinations brown. Body and wings dull purplish gray. Fore wings with the lines slightly darker; antemedial line geminate, wavy, slightly outcurved; a medial

lunular line outbent and touching the dark discocellular line, the lunules inverted and touching the postmedial, forming indistinct spots; postmedial geminate, lunular. Hind wings tinged with whitish on costal margin; a postmedial geminate line, hardly visible; some dark shadings on inner margin. Wings below duller with only the postmedial lines faintly indicated.

Expanse.—58 mm.

Habitat.—Rockstone Essequebo River, British Guiana.

Type.—Cat. No. 22464, U.S.N.M.

Family NOTODONTIDAE.

TAGELA CAYUGA, new species.

Male.—Palpi, head, collar, and thorax dark reddish brown; vertex lilacine brown with some white hairs; two white spots on neck. Abdomen dark grayish brown. Fore wings: inner margin broadly light brown, also the apical space beyond cell and from just below vein 5 to costa; wing otherwise dark brown irrorated with blue scales and crossed by numerous black brown wavy lines; on inner margin the lines are only slightly darker than ground color; a small black brown antemedial spot below cell and a slightly larger similar spot at lower end of cell; a dark streak below vein 5 to the interrupted subterminal line; marginal triangular dark spots between veins 3 and 7. Hind wings dull dark grayish brown. Wings below dull grayish brown.

Expanse.—46 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22465, U.S.N.M.

ANUROCAMPA ALBIFASCIATA, new species.

Male.—Antennae black. Head and thorax black with scattered dark yellow and a few whitish hairs. Abdomen black, the segments posteriorly with transverse dark yellow lines. Legs fuscous. Wings fuscous. Fore wings: a whitish yellow point at base of cell; some very indistinct whitish antemedial spots; a postmedial white shade cut by the fuscous veins, widest from vein 3 to vein 8. Underneath similar, the white shade less distinct.

Expanse.—50 mm.

Habitat.—Chaco, Argentina.

Type.—Cat. No. 22466, U.S.N.M.

PROELYMIOTIS SERRATA, new species.

Male.—Palpi fawn color, the second joint tipped with whitish buff. Head fawn color, the tufts whitish buff. Collar and thorax mottled fawn color and whitish buff. Abdomen above dark grayish brown. Fore wings: basal half of wing fawn color shaded with brown at base, on costal, and on inner margin; the subcostal, median and submedian

veins finely grayish; a subbasal darker line on costal margin; medial line outcurved across cell, somewhat inbent below it, dark brown closely preceded by a fine reddish brown line, and closely followed by a black brown line, slightly more remote from vein 2 to inner margin; the space to postmedial gray, darkest between vein 2 and discocellular, paler above and beyond cell to costa; a white line on discocellular; postmedial fine, lunular, fuscous brown, followed by a fawn color shade on which is a reddish brown line interrupted by black and white points on veins; and interrupted subterminal lunular white line almost obliterated by fuscous shadings from below vein 5 to vein 7; termen shaded with gray and brown inwardly edged by a nearly straight fine fuscous brown line; a similar terminal line; cilia brown with whitish buff spots at veins. Hind wings dark grayish brown, cilia whitish. Wings below dark grayish brown; the costa of fore wings narrowly whitish buff, with dark spots toward apex.

Expanse.—42 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22467, U.S.N.M.

PROELYMIOTIS MANACOIDES, new species.

Male.—Palpi and head dark reddish brown irrorated with white. Collar white irrorated with dark brown. Thorax lilacine streaked and irrorated with dark brown. Abdomen lilacine brown mottled with white and with white segmental lines. Fore wings lilacine brown; costal margin with dark brown shading except at base; base of wing narrowly white with dark brown mottling; a white streak above submedian to antemedial line, and a shorter black brown streak on it close to veins; basal half of cell white with dark brown mottling; antemedial line from subcostal near middle of wing white, preceded in cell by a black brown spot, inbent below median cutting a fine dark streak on fold, then wavily downbent and followed by a short black brown streak above submedian; from antemedial line on lower part of cell and below it a dark brown shade, expanding on discocellular, extends toward outer margin; a conspicuous short and thick white streak below vein 5 and beyond cell, becoming outwardly oblique and upbent to vein 7 as a fine white line; a subterminal fine lunular line marked by small black brown spots on interspaces; termen with darker shadings and some small dark points towards apex. Hind wings light grayish brown.

Expanse.—43 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22468, U.S.N.M.

LYSANA CAUDATULA, new species.

Male.—Palpi white mottled with lilacine. Frons white; tufts at base of antennae pale lilacine gray. Collar and thorax lilacine gray;

some dark brown shading behind head and on front of thorax. Abdomen lilacine brown, the base white. Fore wings: costal edge pale gray with a white line below it to apex; base of wing from subcostal to submedian roseate brown darkest in cell, limited by an outbent white line, the space from this line to postmedial pale roseate brown except on inner margin which is whitish gray; an oblique dark brown medial spot in cell, outwardly edged by white which forms an inbent line along median to well before middle of cell and is then wavily outbent to middle of inner margin; a roseate brown line on discocellular edged with white; postmedial white, deeply outbent and sharply angled at vein 7, inbent, sinuous to vein 2, forming two lunules from vein 2 to inner margin, preceded by white streaks on veins; outer margin broadly dark grayish brown; geminate black points divided by a white point on veins near postmedial; a fine wavy and lunular subterminal white line, preceded and followed by white mottling especially between veins 3 and 4. Hind wings reddish brown shaded with fuscous along outer margin, the inner margin whitish in part; anal angle with a tuft of long hairs and a small dark spot above it; cilia white from apex to vein 3.

Expanse.—38 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22469, U.S.N.M.

KALKOMA ZAPATA, new species.

Male.—Head and body dark gray; transverse fuscous shadings dorsally on abdomen; antennae pale ocherous. Fore wings gray, the base narrowly whitish limited by the fine, black, geminate basal line, followed below cell and submedian by a roseate shade to the antemedial line which is also fine, black, geminate, lunular and slightly outcurved from costa; end of cell somewhat paler gray; a roseate shade on discocellular crossed by a dark line; postmedial line fine, black, inbent on costa, then somewhat outcurved and wavy, followed by a broad fuscous shade from vein 6 to costa, and with traces of a very fine second line from vein 4 to inner margin; a heavily marked subterminal, irregular, black line from termen at vein 7 to inner margin near tornus, preceded by a white shade broadest toward apex; cilia white mottled with gray. Hind wings white; a dark gray line on discocellular; a fine postmedial line, and a large shade at apex. Fore wings below dark gray, the inner margin white. Hind wings below white; costal margin broadly dark gray; a small discal spot and postmedial line.

Expanse.—20 mm.

Habitat.—Presidio River, Sinaloa, Mexico.

Type.—Cat. No. 22470, U.S.N.M.

CRINODES CRENULATA, new species.

Male.—Palpi and frons dark brown. Antennae with the shaft cream color, the pectinations light brown. Vertex, collar, and thorax gray; dark brown transverse lines on collar and patagia. Abdomen ochreous; a dorsal gray tuft at base; white anal tuft mottled with white fan-shaped scales. Fore wings mostly gray; long dark steel gray streaks from base on costa, below cell, and along submedian vein; a velvety black, interrupted antemedial line, inwardly edged with white, outangled on costa to near end of cell, less deeply angled in cell, very slightly so below cell, and on submedian outangled to postmedial line and inbent to near base of inner margin; a white shade mottled with pale brown at end of cell; postmedial fuscous, slightly outcurved beyond cell, incurved below it, followed by a finer less distinct parallel line, and then by the subterminal line which is also parallel and heavily marked, especially from vein 4 to costa, these three lines suffusing in a dark shade on inner margin; the space between these lines shaded with brown; a terminal black line preceded by whitish shading on interspaces; cilia whitish with dark spots at veins. Hind wings: the base pale ochreous, the outer portion fuscous with traces of two fine wavy postmedial lines. Wings below bone color with broad postmedial fuscous shading not reaching either the costal or inner margins.

Expanse.—55 mm.

Habitat.—Sinaloa, Mexico.

Type.—Cat. No. 22471, U.S.N.M.

According to the key this species would fall in the genus *Proelymiotis*, but it is every way, except the crenulate margin, typically a *Crinodes*. In appearance it comes very close to *C. nebulosa* Schaus from Argentina.

DASYLOPHIA EMINENS, new species.

Male.—Head, thorax, and abdomen grayish white; palpi gray laterally streaked with brown on terminal half; collar brown mottled with some whitish hairs. Fore wings grayish white; costal edge dark brown, a fine black streak below it along medial third of wing; a small brown spot above cell close before middle crossed by a very irregular fine fuscous and outcurved medial line which barely reaches inner margin; a black line from base below cell reaching the medial line, the medial vein to this line dark brown, beyond it streaked with black to beyond cell near vein 5; a fuscous brown line in cell anteriorly from medial line, interrupted by discocellular and continuing between veins 5 and 6 to near termen; a black line and fuscous shading between veins 6 and 7, and a terminal black streak above vein 7; some fuscous shading below end of cell, these lines and shading forming an undefined dark oblique shade to termen just below apex; base of veins 6 and 7, veins 2 to 5 terminally also sub-

median vein white irrorated with black; a fine fuscous interrupted line from vein 2 oblique to termen between veins 4 and 5; a subterminal small black spot above vein 2; inner margin shaded with very pale brown except at base which is white; some terminal dark shadings on interspaces. Hind wings white, the veins fuscous; the outer margin broadly fuscous. Wings below white; the forewings with fuscous shading from cell obliquely to apex.

Expanse.—38 mm.

Habitat.—Venadio, Sinaloa, Mexico.

Type.—Cat. No. 22472, U.S.N.M.

DASYLOPHIA GORAXA, new species.

Male.—Palpi and frons grayish brown, some dark brown shading toward vertex. Collar dark brown. Thorax gray; fine dark streaks on patagia. Abdomen above dark gray, the three basal segments with dark brown hairs. Fore wings grayish brown with black dotted streaks between the veins from medial to postmedial lines; a fine brown medial line, very indistinct preceded below cell by a large black spot, oblique and narrowing toward base and submedian; a distinct brown, wavy, postmedial line followed by a whitish shade, divided by a parallel fuscous line, and this white shade is followed by a black shade wide on costa, narrowing to vein 4, slightly wider below vein 4, and extending to vein 2, below which the shade is only faintly indicated to inner margin; a subterminal black spot above vein 2; marginal small angled brown spots on interspaces; a terminal interrupted black line. Hind wings whitish, the veins brown, the inner and outer margins smoky brown.

Expanse.—38 mm.

Habitat.—Venadio, Sinaloa, Mexico.

Type.—Cat. No. 22473 U.S.N.M.

This species comes nearest D. *nigrescens* Schaus, which has the entire base black.

DICENTRIA QUIROSIA, new species.

Male.—Head, palpi, collar and thorax buff shaded with lilacine; tips of patagia and shoulders shaded with black. Abdomen dark grayish brown; reddish brown tufts at base, the anal segments buff. Forewings pale buff; base of costa shaded with brown; a fuscous gray streak in cell at base; a faint grayish medialline barely curved in cell; a velvety black point on discocellular; postmedial line fine, outcurved around cell, then parallel with medial line to inner margin; dark brown streaks between veins 4 and 5, and 5 and 6 from cell to near termen; a faint grayish streak above vein 6; an outer series of short brown streaks on veins and subterminal spots on interspaces; lunular smaller terminal spots and streaks on veins expanding into spots on cilia. Hind wings white; the inner margin pale buff; a

small fuscous spot at anal angle. Fore wings below white; a fuscous shade at end of cell to subcostal vein, followed by a gray shade to apex; the costa whitish buff. Hind wings below entirely white.

Expanse.—37 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22474, U.S.N.M.

Comes nearest *D. centralis* Herrich-Schäffer.

DICENTRIA MARIMBA, new species.

Male.—Palpi and frons whitish buff; neck behind dark brown. Collar and thorax lilacine brown. Abdomen above dark brownish gray, the anal segment dorsally shaded with whitish buff. Fore wings mostly brownish gray, the veins irrorated with black and white; base of costa and cell darker, browner; cell otherwise and a shade below cell pale olive buff with darker irrorations; an antemedial fine, darker, geminate line, outcurved across cell; a brown line on discocellular edged with white, followed by a fuscous brown streak between veins 4 and 5 to postmedial; postmedial very deeply outcurved beyond cell, lunular dentate, geminate from costa to vein 4, then single followed by dark points on veins; outer margin darker shaded with faint traces of a subterminal line; small marginal white spots above and below vein 2; small dark spots from above vein 3 to costa; cilia dark brown with buff spots at interspaces. Hind wings white thinly scaled, the veins terminally fuscous brown, with an interrupted similar terminal line; a dark spot at anal angle reaching vein 2; a dark streak in fold of inner margin, separated from anal spot by a small chalk white spot; cilia white except at anal angle. Fore wings below white shaded with dark grayish brown along costa and above vein 5 to subcostal. Hind wings below white; some fuscous brown shading at anal angle extending on cilia.

Expanse—36 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22475, U.S.N.M.

The female of this species was erroneously described as the female of *D. limosoides* Schaus.[1]

DICENTRIA LERMA, new species.

Male.—Palpi whitish; frons mottled pale buff and brown. Vertex, collar, thorax, and abdomen above fuscous brown, the anal segment dorsally shaded with light brown; abdomen underneath creamy white. Fore wings dark brownish gray; base narrowly black brown; a fine black streak below cell; a fine black streak in cell expanding at discocellular and extending as a thick black line along vein 5 to termen; very faint traces of medial lines; a broad darker medial

[1] Am. Mag. Nat. Hist. ser. 8, vol. 7, 1891, p. 270.

shade on inner margin; outer half of costal margin yellowish white, crossed by some fine dark lines; a white streak below vein 6 not reaching termen; a whitish shade along vein 4 to termen; a fuscous streak above vein 6 not reaching termen; a fuscous shade between veins 2 and 3 to termen; a pale shade at tornus; veins on outer third partly irrorated or streaked with black; terminal dark spots on interspaces; the black streaks on veins expanding on the cilia. Hind wings white, thinly scaled; a dark streak in fold of inner margin; anal angle black. Hind wings below white; cilia at anal angle black.

Expanse.—38 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22476, U.S.N.M.

Close to *D. psamathe* Schaus.

DISPHRAGIS CARIBA, new species.

Male.—Palpi and frons mottled brown and fuscous gray. Vertex, collar and thorax dark olive green mottled with gray; patagia more grayish with a little green mottling. Abdomen brownish gray; a reddish brown dorsal tuft at base; the two anal segments shaded above with white and green. Fore wings brown; a basal green fascia crossed by two dark lines, slightly outbent from costa; a medial green wavy fascia, edged by dark brown lines and divided by a single line, this fascia being somewhat outset in cell; the space between this fascia and postmedial pale brown tinged with lilacine, also a gray tint before discocellular and between veins 2 and 3; a brown incurved line on discocellular; two brown lines on costa above end of cell and from there to near apex, the costal margin is green marked by dark spots on edge; postmedial fine, geminate, lunular opposite cell and closely followed by another straighter line, which is interrupted by a green spot between veins 3 and 4; outer margin green inwardly edged by an irregular whitish green subterminal line. Hind wings lilacine brown crossed by a darker fascia edged with fuscous; the outer margin broadly dull purplish brown. Fore wings below fuscous the margins bone colors. Hind wings below bone color; a fuscous spot at anal angle.

Expanse.—42 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22477, U.S.N.M.

HEMICERAS COATINA, new species.

Male.—Palpi, frons, collar, and patagia purple brown; palpi streaked in front with white; vertex white; a white line on collar behind; thorax medially fuscous brown with a whitish spot behind crossed by two fuscous lines. Abdomen light brown, with pale segmental lines

and a dorsal darker brown tuft at base. Fore wings purple brown; costa finely white; antemedial white points on veins preceded by a large cluster of white scales between cell and submedian; a black point on discocellular; a series of white points from costa near apex to sinus on inner margin; these points larger towards costa, and geminate except on vein 3 and 4; parallel subterminal points from apex to vein 5 and on inner margin. Hind wings dull pale brown, darker on outer margin. Fore wings below pale silky brown, whitish on inner margin. Hind wings below white without fovea.

Expanse.—40 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22478, U.S.N.M.

This species in color and in the macular postmedial lines resembles *H. muscosa* Schaus; in the presence of the cluster of scales before the antemedial line it approaches *H. sparsipennis* Walker.

Family MEGALOPYGIDAE.

NORAPE FRONTALIS, new species.

Male.—Body and wings white, the latter somewhat silvery. Antennae with the shaft and pectinations crimson. Frons light brown. Throat and tarsi dark brown.

Expanse.—27 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22479, U.S.N.M.

ARCHYLUS LOANUS, new species.

Male.—Body white; pale brown shading on collar behind, on tips of patagia, and forming fine segmental lines on abdomen; throat and palpi brown; antennae streaked brown and white. Fore wings white; a brown spot at base; subbasal brown spots on costa and in cell; smoky streaks at end of cell, and shorter streaks beyond it; longer fuscous brown streaks above end of cell on costal and subcostal veins; pale ochreous shading on inner margin and medially from submedian to median; postmedial short, paired ochreous streaks at veins; pale ochreous marginal spots on interspaces. Hind wings white. Wings below white, the costal margin of fore wing shaded with brown.

Expanse.—25 mm.

Habitat.—Venadio, Sinaloa, Mexico.

Type.—Cat. No. 22480, U.S.N.M.

TROSIA ROSITA, new species.

Male.—Antennae fuscous, the base of shaft white; head, front of collar, and four spots on thorax crimson, the collar and thorax other-

wise white. Abdomen rose color, darker at base dorsally, the anal hairs white; tarsi brown, streaked with black and mottled with white hairs. Fore wings rose color, shaded with white on basal half of inner margin; cilia white; a row of black points, four from end of cell to inner margin, one above vein 5, and one above vein 6; the costal margin crimson. Hind wings rose color, the cilia white. Wings below rose color, the cilia white.

Expanse.—32 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 22481, U.S.N.M.

VESCOA GLUTINA, new species.

Male.—Antennae with the shaft white, the pectinations light brown. Frons, collar in front, and thorax light brown; vertex, collar behind, and patagia white. Abdomen above fuscous brown, underneath white. Fore wings light brown, the cilia white; a fine white streak below cell, and one below costa at apex; a white spot at base of inner margin from which a better defined sinuous white line extends above submedian to tornus, but is slightly interrupted before reaching it. Hind wings light brown, the inner margin and cilia white; faint terminal white streaks between the veins. Wings below white; the cell and costal margin of fore wings light brown.

Expanse.—18 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22482, U.S.N.M.

MEGALOPYGE CHACONA, new species.

Male.—Antennae black brown. Head brownish yellow; collar and thorax fuscous, the hair on collar tipped behind with brownish yellow and some similar hairs laterally on thorax. Abdomen brownish yellow, the anal segment fuscous; very indistinct dark segmental lines. Fore wings fuscous, shaded with gray about tornus; veins all white; a white shade at end of cell, joined by a postmedial white shade from costa, partly cutting off a portion of the dark ground color; postmedial intervenal white streaks. Hind wings white; fuscous scaling on inner margin; terminal space broadly fuscous, cut by white veins. Underneath the white predominates, leaving the base and terminal space fuscous, the latter cut by white veins.

Expanse.—30 mm.

Habitat.—Chaco, Argentina.

Type.—Cat. No. 22483, U.S.N.M.

Kindly sent to me by Don Pedro Jorgensen, close to *M. uruguayensis* Berg.

Family LIMACODIDAE.

PARASA MAYSI, new species.

Male.—Antennae and frons light brown; vertex, collar, and thorax green; abdomen brown. Fore wings brown, the veins faintly darker;

a green medial band from costa beyond cell to middle of inner margin, where it is widest, outwardly edged by a fine dark brown line. Hind wings fuscous, the margins brown. Wings below paler brown, the disk of fore wing shaded with pale green.

Expanse.—18 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22484, U.S.N.M.

Near *P. minima* Schaus, which has yellow hind wings.

METRAGA HOBOA, new species.

Male.—Body blackish brown, the tips of palpi paler. Fore wings dark silky slate color; a small velvety fuscous brown spot in cell, and a similar streak below cell at one-third from base, oblique to near tornus, preceded by an upright, fine, wavy white line from median vein to inner margin; two small brown spots well beyond cell, followed by a series of brown marginal spots. Hind wings brown.

Expanse.—14 mm.

Habitat.—Venadio, Sinaloa, Mexico.

Type.—Cat. No. 22485, U.S.N.M.

MIRESA DORIENS, new species.

Male.—Body silky fuscous brown, the tips of palpi and antennae light brown. Forewings silky dark lilacine brown with fuscous brown velvety markings; a patch of coalescing spots below end of cell, inbent towards inner margin; subterminal spots, the spot below vein 2 elongate, the spots between veins 2 and 4 small, those from vein 4 to vein 8 coalescing and expanding between veins 5 and 7, and with white points on veins 7 and 8; postmedial white points on veins 3 and 5, and a white point medially below cell; at end of cell a semi-hyaline spot with a few dark scales. Hindwings dark brown; a semi-hyaline streak in and beyond cell; a terminal fuscous line; base of cilia fuscous, the tips silvery white. Wings below dark brown, the semihyaline spot on forewing larger.

Expanse.—24 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 22486, U.S.N.M.

EUPROSTERNA BARRANCA, new species.

Male.—Head and thorax brown, the palpi fuscous brown in front, Abdomen grayish brown, the dorsal tufts at base brown. Forewings silky brown with a few scattered fuscous brown scales, the basal half a trifle darker than the outer half, separated by a vague dark line, incurved below end of cell and faintly lunular from there to inner margin; a very faint subterminal line. Hindwings grayish brown. Wings below brown.

Expanse.—22 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 22'87, U.S.N.M.

NATADA CORA, new species.

Male.—Body yellowish buff. Forewings yellowish buff, thickly scaled; some fine black irrorations forming a faint inbent line from beyond cell to close below vein 2; a faint darker subterminal shade approaching termen above tornus; the termen paler. Hindwings ochreous shaded with fuscous scaling. Wings underneath pale yellow; some fuscous irrorations at end of cell on forewing.

Expanse.—16 mm.

Habitat.—Venadio, Sinaloa, Mexico.

Type.—Cat. No. 22488, U.S.N.M.

NARASOPSIS VYNIA, new species.

Male.—Head white, palpi outwardly light brown. Body and wings pale buff. Forewings: a few scattered black scales; some brownish shading antemedially above inner margin and in cell medially, especially at origin of vein 2; a fine blackish line on discocellular; a subterminal rather broad darker brown shade on which is a cluster of black scales opposite cell; underneath the disk of forewing is brownish and the discellular mark clearer. Hind wings below: costa with dark irrorations; a black discal spot.

Expanse.—13 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22489, U.S.N.M.

PEROLA GAYA, new species.

Male.—Body and wings dull dark grayish brown with some scattered pale ochreous irrorations. Forewings: a fine pale line from apex to middle of inner margin, partly geminate; a fine pale terminal line. Hind wings with a fine pale line on base of cilia.

Expanse.—20 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22490, U.S.N.M.

PEROLA OSSEATA, new species.

Male.—Head and thorax bone color; abdomen tinged with ocher, especially the large dorsal tufts. Forewings bone color with a few scattered black scales; a cluster of black scales on discocellular; a postmedial line of ground color defined by grayish shading; similar shading at base of inner margin and on outer margin. Hind wings pale ochreous with a large smoky shade below costa on outer half. Wings below bone color; some darker postmedial shading on forewings below costa.

Expanse.—17 mm.
Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 22491, U.S.N.M.

PEROLA SINALOENSIS, new species.

Male.—Body dark grayish brown. Wings bright ochreous gray the forewings thickly irrorated with fine curly scales, darkest preceding a pale postmedial line which runs parallel with the termen; the base of cilia paler. Wings below without markings.
Expanse.—24 mm.
Habitat.—Venadio, Sinaloa, Mexico.
Type.—Cat. No. 22492, U.S.N.M.

TANADEMA RUFESCENS, new species.

Male.—Body bright rufous; palpi upturned reaching above vertex. Forewings mottled with iridescent lilacine gray scaling; pale buff and light brown shadings at base, near tornus, at end of cell extending to costa, and beyond cell, also forming a round spot edged with dark brown between veins 3 and 5 close to cell; a small fuscous spot medially below cell. Hind wings brownish gray; a small dark brown spot at anal angle.
Expanse.—17 mm.
Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 22493, U.S.N.M.

TANADEMA SEMIVITREA, new species.

Male.—Head dark brown; palpi and antennae light brown. Collar, thorax, and base of abdomen very dark gray; abdomen otherwise fuscous. Fore wings dark brown tinged with red on margins; the disk of wing from near base to near termen hyaline irrorated with black scales; a small black point on discocellular. Hind wings hyaline with only a few black irrorations; the costal and inner margins broadly fuscous, the termen narrowly so.
Expanse.—17 mm.
Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 22494, U.S.N.M.

LITHACODES ALBIPUNCTA, new species.

Male.—Head and thorax mottled gray and brown; the abdomen somewhat paler. Fore wings broad, the termen almost straight, pale buff, irrorated with brown; the base to near end of cell, but not quite reaching inner margin fuscous brown, outwardly limited by a black outbent line from costa across discocellular; a small white spot circled with black below end of cell; a broad grayish postmedial shade, narrowing toward tornus; a small dark spot at apex.

Expanse.—17 mm.
Habitat.—Venadio, Sinaloa, Mexico.
Type.—Cat. No. 22495, U.S.N.M.

LITHACODES SCHEVI, new species.

Male.—Palpi brown; collar and thorax yellow; abdomen roseate brown. Wings silky ochreous yellow tinged with reddish, the veins finely darker marked. Fore wings: a fine dark line from apex to inner margin before middle; a finer less distinct subterminal line from apex, apparently obsolete below vein 2. Wings below paler, the veins only partly dark.

Expanse.—18 mm.
Habitat.—Venadio, Sinaloa, Mexico.
Type.—Cat. No. 22496, U.S.N.M.

Family DALCERIDAE.

ACRAGA MORIBUNDA, new species.

Male.—Antennae yellowish ocher. Collar, thorax, and base of abdomen orange vermillion; abdomen and fore wings paler, the veins yellowish ocher, also the hind wings. Wings below uniformly yellowish ocher.

Expanse.—33 mm.
Habitat.—Volcan de Santa Maria, Guatemala.
Type.—Cat. No. 22497, U.S.N.M.

PARACREAGA PULVERINA, new species.

Male.—Antennae, head, thorax, and legs yellowish white. Abdomen white. Fore wings whitish yellow thinly irrorated with fine fuscous brown scales; these irrorations outline an irregular ovate spot on outer portion of wing, the anterior portion curved above discocellular, the posterior portion narrowing and not quite meeting on inner margin; a small brown spot antemedially on submedian. Hind wings white, wings below white; costa of fore wings whitish ocher irrorated with brown.

Expanse.—15 mm.
Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 22498, U.S.N.M.

ACRAGOPSIS CHIRMA, new species.

Male.—Body and fore wings golden yellow; hind wings paler yellow.

Expanse.—13 mm.
Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 22499, U.S.N.M.

Family PEROPHORIDAE.

LACOSOMA PERPLEXA, new species.

Male.—Body and wings buff gray, the latter with some black irrorations. Fore wings slightly incurved below apex and produced between veins 5 and 2; some roseate shading at end of cell and beyond it, also faintly below cell at base; a fine black streak on discocellular; post-medial line fine, brownish, slightly outcurved beyond cell, perpendicular from vein 5 to inner margin. Hind wings: the outer margin rounded; the medial line slightly heavier; some faint roseate shading in cell; termen shaded with pale brown. Fore wings below similar, but the shading in cell and beyond more extended and redder. Hind wings below similar, but without any roseate shading.

Expanse.—29 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 22500, U.S.N.M.

Distinguished from similarly colored species by the outer margin not being crenulate.

CICINNUS MULATRO, new species.

Female.—Body and wings ochre brown; Fore wings: a fuscous line from just beyond middle of inner margin, oblique to vein 7, followed by a line of black irrorations, the base of each scale white; from vein 7 to apex this line continues and is fuscous brown; a fine, black, oblique streak at end of cell. Hind wings with the line and irrorations medial. Fore wings below: a black streak on discocellular; no line except a short fuscous streak at apex. Hind wings below: a few black irrorations, chiefly near costa; a postmedial short black line on inner margin.

Expanse.—59 mm.

Habitat.—Cayuga Guatemala.

Type.—Cat. No. 22501, U.S.N.M.

One specimen at light in October. Allied to *C. joanna* Schaus.

CICINNUS MOTAGUS, new species.

Male.—Head, collar, abdomen above, and legs pale brown; thorax lilacine gray, with a few scattered fuscous scales. Wings gray with some scattered black scales. Fore wings: a faint pale brown antemedial line; two superposed hyaline spots at end of cell narrowly edged and separated by a brown line tinged with red at median vein; postmedial line fine, fuscous brown, down bent to vein 8 on costa, then outbent towards apex, angled and inbent to inner margin followed by a reddish spot between veins 6 and 8, and below 6 by a narrow brownish shade coalescing at vein 4 with a similar shade

from tornus. Hind wings: two confluent small hyaline spots at end of cell, partly interrupting the fine dark medial line; some red shading below lower angle of cell. Fore wings below suffused with brown except on inner margin and on outer margin above tornus, the red shadings more extended; the postmedial line indistinct. Hind wings below as above; some reddish shading also above hyaline spots; the line fine, outcurved, almost sub-marginal, upcurved between vein 3 and inner margin.

Expanse.—40 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 22502, U.S.N.M.

Closely allied to *C. beta* Schaus, but grayer with paler markings and without any black markings on the underside.

CICINNUS SYLVIA, new species.

Male.—Body and wings pale buff, the latter with a few darker irrorations and grayish shadings. Fore wings falcate; a fine pale reddish brown, wavy, antemedial line; two small hyaline spots at end of cell, placed obliquely and followed by a contiguous dark brown spot, its outer side rounded; postmedial line outwardly curved below costa, dark reddish brown edged with paler brown; apex brown; a fine gray line follows closely the postmedial from inner margin to vein 8, and is joined at vein 5 by a similar line from tornus; outer margin devoid of gray shading. Hind wings: a minute hyaline discal spot followed by a heavy dark line as on fore wings. Wings below clearer pale buff; the transverse line brighter reddish brown; the hyaline spot on hind wing also followed by a dark brown spot.

Expanse.—40 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 22503, U.S.N.M

OBSERVATION ON LIVING SPECIMENS OF IRIDIA DIAPHANA, A SPECIES OF FORAMINIFERA.

By Joseph Augustine Cushman,
Of the Boston Society of Natural History.

While at the Tortugas laboratory of the Carnegie Institution of Washington, through the kindness of the director, Dr. Alfred G. Mayor, I collected numerous foraminifera. Among these were living specimens which are apparently identical with or close to the species described by Heron-Allen and Earland as *Iridia diaphana* [1]. Specimens are attached to various objects but the most accessible are those which are adherent to the broad leaves of *Posidonia* which covers the bottom in shallow water in various places.

In general the test of the Tortugas specimens of *Iridia* is made largely of calcareous sand grains (pl. 19, fig. 1) in a slightly raised dome, but larger specimens usually are more or less irregular in outline. The upper surface only is composed of agglutinated material, the lower surface and the lining of the upper side being of thin chitinous material forming an enclosing membrane. The calcareous material may be entirely dissolved in weak acid leaving this chitinous envelope intact. In its living state viewed from above the interior of the test is not visible, due to the opaque wall of sand grains. With a thin scalpel the entire test may easily be removed from the leaf of *Posidonia* and transferred to the water. If placed upside down and examined with low power more of the structure of the test can be seen. A small sector of this is shown in plate 19, figure 2. Seen from below there is at once distinguished a central more or less homogeneous mass of a light yellowish brown color surrounded by a slightly darker periphery. Outside this is a peripheral band to the edge of the test, of lighter color with practically no protoplasm in most of the area, but here and there at intervals with irregular bands passing from the central protoplasmic mass to the periphery of the test. These are of a light yellow color in general like that of the central mass. In each of these radial bands appear several more or less distinct channels and from these the protoplasm streams back and

[1] Trans. Zool. Soc. London, vol. 20, 1914, p. 371, pl. 36.

forth from the exterior. The only connection between the central cavity of the test and the exterior seems to be through these radial channels. When placed with the convex side downward the chitinous layer may be gently pressed, causing the protoplasmic mass of the central portion to sway back and forth; but it is held firmly within the chitinous envelope unless this is ruptured by the rough treatment. The chitinous layer is, however, tough and capable of considerable resistance.

By reflected light the protoplasmic portion is of a peculiar light yellowish brown color against the white of the sand grains of the test with the lines of the radial channels and the peripheral portion of the central mass of a deeper orange color. With high power this deeper color is seen to be due to the presence of great numbers of unicellular algae, which seem to be rather closely confined to these areas or at least to be concentrated there in greater numbers. These algae are brownish in color, of very uniform size, about 6–7 μ in length and apparently have a commensal relation with the protozoan as will be noted later.

Usually within five minutes after the foraminifer has been detached from the *Posidonia* and placed in fresh sea water pseudopodia appear at the periphery. These are thrust out rapidly and carry with them numbers of the unicellular algae already mentioned. These seemingly adhere to the sides of the fine pseudopodia, as shown in plate 19, figure 3. The pseudopodia themselves are largely of clear protoplasm with fine "knots" at irregular intervals of slightly more compact material. There is a tendency for the algae to collect at the junctions of the pseudopodia. In the finer pseudopodia there is often a movement in the opposite directions at the same time, one side carrying the "knots" and algae outward, the other side carrying them backward toward the test. This movement may be suddenly interrupted and all flow in one way or the other or each become reversed. When steadily moving the protoplasm of the finer pseudopodia is carried along at an average speed of about 1 mm. a minute from actual measuments with micrometer scale and stop watch.

The unicellular algae evidently have a commensal relation to the foraminifer, as they are usually associated with the pseudopodia. When the pseudopodia are extended and active nearly all the algae are outside the actual test and when quiescent they are apparently stored in the area at the peripheral portion of the central mass and in the radial channels, as already noted.

The protoplasmic body of the animal has the power of leaving the test at will. This was noted in cases where specimens were detached and left over night in sea water and in the morning found at some distance from their empty test. Whether this withdrawal was through the radial canals or through some breaking down of the chitinous

lining could not be determined. These specimens had practically no included algae. When such specimens have left their test they are capable of extended and fairly rapid movement. One such specimen which had left its test voluntarily is shown in plate 20, figure 1. It is elongate, with a definite "head" to the body and numerous pseudopodia streaming behind, as well as a few in front. The "body" portion with its pseudopodia formed a line more than an inch in length. During its movement records of its rate were taken and these were from 1 minute and 40 seconds to 2 minutes for a distance of a millimeter. Later other specimens were found to have a much more rapid rate of motion as will be given.

The movements and changes in this specimen seem worthy of note. After traveling for a considerable distance in the elongate form (pl. 20, fig. 1) it became concentrated into a more rounded form, which semingly was about to divide into two portions by its constrictions, but later started out again, in an elongated form. These (pl. 20, figs. 2-6; pl. 21, figs. 1-7) were drawn with camera lucida at intervals while the whole protoplasmic mass was in slow but rather steady motion. Toward the end of this series motion became less rapid and nearly ceased, but later a clearer "tongue" of protoplasm was thrust out (pl. 21, fig. 7) and motion again became became more rapid.

After the elongate form and more rapid movement had been resumed portions were cut off with a scalpel. Where a small portion of the end was severed, the detached mass quickly became globular by concentration of the protoplasmic portions; then after a short time numerous fine pseudopodia were sent off very rapidly in all directions until fusion took place with the original mass, which also during the same period had sent back numerous fine pseudopodia from the direction of the cut. When fusion of the pseudopodia takes place the smaller severed portion sets up a rapid streaming toward the larger mass until the two are once more united, when shape and motion are carried out as before.

Where a small mass was removed and placed at some distance from the larger mass the same process was repeated, but after fusion was not made, owing to the distance, the smaller mass became concentrated in a subspherical mass, where it remained quiescent for two days, then gradually broke down and disintegrated. This smaller portion probably had no nuclear material and was unable to regenerate. Later on the larger mass of this particular specimen approached a leaf of *Posidonia* nearly half an inch from the bottom, and after sending out numerous pseudopodia gradually lifted the body to the edge of the leaf and settled there.

Numerous specimens were removed from their tests by cutting away the chitinous layer at the base and taking the mass of proto-

plasm out of the test. Such specimens recovered rapidly and sent out pseudopodia like normal specimens in their test. The rate of movement in these specimens was recorded in several cases. There seems to be a rhythmic motion when the specimen is moving in a definite direction. After an interval of rapid motion the whole gradually slows up and then again becomes rapid, although the alternation is somewhat irregular. The following measurements of the time of traveling one-sixth of a millimeter are for consecutive intervals during the time that the movement covered 4 millimeters. It represents the acceleration of speed during a portion of one of these rhythmic intervals:

Minutes.	Seconds.	Minutes.	Seconds.	Minutes.	Seconds.
1	17	1	40	....	24
2	20	2	30	....	19
1	11	1	58	....	12
1	5	1	20	....	14
0	54	....	54	....	15
1	8	....	50	....	15
1	13	....	40	....	12
1	32	....	26	....	14

When two or more specimens are taken from the test and placed near each other pseudopodia are sent out in the usual manner but instead of fusing, as in the case of the parts of a severed specimen, seem to repel one another. The pseudopodia come nearly or quite in contact, then bunch up, forming a considerable mass of greater density, after which the flow is in opposite directions and the protoplasm is withdrawn back to the central masses and movement starts off in other directions. A similar repelling tendency was noted when two species of different families were in motion. In such cases when the pseudopodia came into contact they concentrated in a similar way and the specimens then moved away at a right angle or more from the original line of movement, so as to avoid one another. In all the specimens examined there was no case in which pseudopodia became fused except in the severed parts of the same specimen. Such observations are similar to those observed in Amoebae according to information given me by Professor Schaefer in his work during the same time at the Tortugas. Such observations do not substantiate theories of fusion of various specimens of the same or different species.

Heron-Allen and Earland in their original notes on this species note that the larger specimens as a rule have coarser material in the test and explain the growth of the test as follows: [1]

[1] Trans. Zool. Soc., London, vol. 20, 1914, pp. 371, 372.

With each increase in the size of the test the inclosing wall of the preceding stage is absorbed so as to leave an undivided cavity, the shape of which varies according to the direction and manner in which additions to the original chamber have been made.

In the case of the Tortugas specimens attached to the leaves of *Posidonia* several inches above the bottom it is difficult to see where new material for growth is acquired. The habit which has already been noted, of leaving the test and moving about as a naked mass of protoplasm, may easily account for this change in material. While in this free state new material from the bottom may easily be ingested and carried about until a new attachment is made. Such specimens were placed in a mass of débris composed of fine sand and fine fragments of glass wool, but although some of this material was taken into the body, no new test was formed in any of the specimens kept in confinement.

Some specimens were killed and stained, but only one of these seemed to show a definite nucleus that is shown here (pl. 19, fig. 1). It has a very large nuclear mass with a definite nuclear membrane surrounded by a large mass of ectoplasm, in which are numerous food particles.

The most interesting observations are the rapid motion, the individual character of specimens when in contact, and the power of leaving the test at will.

EXPLANATION OF PLATES.

Plate 19.

Fig. 1. Animal of *Iridia diaphana*, test dissolved away, leaving the protoplasmic mass with a single large nucleus, nuclear wall, an irregular mass of ectoplasm containing a few symbiotic algae, and food particles, × 100. Specimen killed and fixed in corrosive sublimate and glacial acetic acid, stained in haematoxylin.

2. Portion of test at periphery from below, × 50. Central mass of protoplasm with very few algae, most of them being near the peripheral portion and in the radial canals leading from the central mass to the periphery of the test. This specimen was quiescent and showed no pseudopodia at the time it was drawn.

3. A branching mass of pseudopodia irregularly bifurcating, mainly composed of clear protoplasm, but with numerous more concentrated masses and a few of the unicellular algae.

Plate 20.

Fig. 1. Elongate flattened mass with numerous pseudpodia traveling toward the direction of the larger end, × 50.

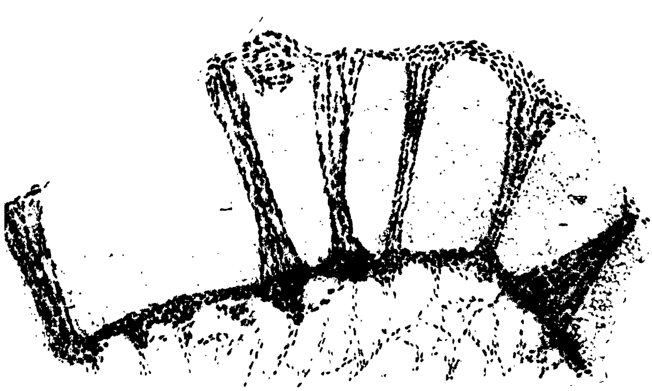
2-6. Various stages in the progress of the same individual in a thicker, more nearly rounded form.

PLATE 21.

FIG. 1–7. Various stages in the progress of the same individual as shown in the previous plate. Figure 1 in a subspherical mass apparently about to divide. In figures 2 and 3 the mass flattened out somewhat and withdrew the numerous pseudopodia which had been sent out at the left in figure 1. In figure 4 the fine pseudopodia in the rear had been entirely withdrawn, and in figure 5 those in front had been largely drawn in, leaving the mass quiescent for a short period. There is apparently a small nuclear mass in the forward clear part.. In figure 6 lines of pseudopodia are again thrust forward, and in figure 7 motion begins again, a tongue of translucent protoplasm being sent forward and a few fine threads being left at the rear as the mass progresses.

1

3

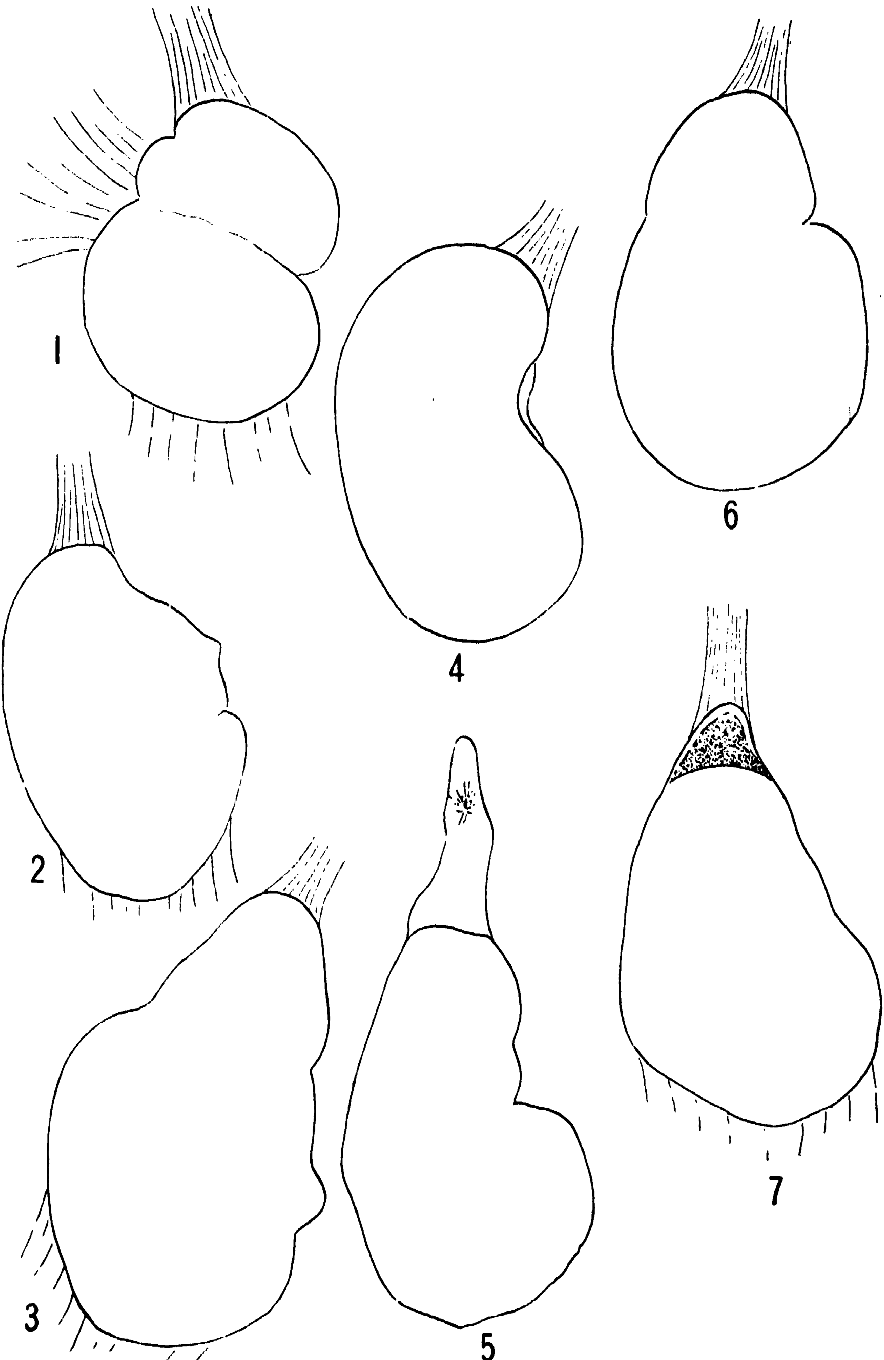


2

THE STRUCTURE OF IRIDIA DIAPHANA.

FOR EXPLANATION OF PLATE SEE PAGE 167.

STAGES IN THE MOVEMENT OF IRIDIA DIAPHANA.



STAGES IN THE MOVEMENT OF IRIDIA DIAPHANA.

FOR EXPLANATION OF PLATE SEE PAGE 168.

THREE NEW SPECIES OF INDIAN DRYNNID PARASITES OF RICE LEAF-HOPPERS.

By S. A. Rohwer,
Of the Bureau of Entomology, United States Department of Agriculture.

The following three new species of Drynnids were received for identification from the imperial entomologist of British India. One of them, *Digonatopus lucidus*, was reared from a nymph of the Jassid, rice leaf-hopper, *Nephotettix bipunctatus* Fabricius, while the other three were reared from the Fulgorid rice leaf-hoppers *Sogata pussana* Distant, *Sogata pallescens* Distant, or *Sogata distincta* Distant. In the case of the Fulgorid parasites the definite species of host was not recorded.

The types of all of the species are in the United States National Museum. The descriptions were prepared with the highest power of the Spencer binocular microscope.

DIGONATOPUS LUCIDUS, new species.

In *Das Tierreich* this species runs to *D. perpolitus* Perkins, but it differs from that species in a number of ways.

Female.—Length, 3 mm. Frons shining and with separate, irregular dorsad-ventrad wrinkles; frontal carina complete, distinct; vertex shining with a few granulations medianly; pronotum smooth shining; constricted part of thorax shining and with some irregular longitudinal wrinkles; propodeum shining and polished anteriorly, posteriorly with well-separated transverse wrinkles; abdomen smooth shining; body, except frons, and the legs with long sparse white hair; anterior leg and antennae as in figures 1 and 2. Black; face, narrow area above antennae and two basal joints of antennae yellowish; legs brownish, with the hind femora and coxae and the anterior femora black.

Type locality.—Pusa, Bihar, India. Described from one female reared, September 20, 1915, from a nymph of *Nephotettix bipunctatus* (Fabricius), by C. S. Misra.

Type.—Cat. No. 22384, U.S.N.M. One female on pin and left foreleg and antennae on Hym. slide 897.

HAPLOGONATOPUS ORIENTALIS, new species.

In the short fourth joint of the anterior tarsi this species differs from the genus *Haplogonatopus* as characterized by Kieffer and Perkins,

but it can not belong to *Cryptogonatopus* because of the concave vertex. It seems to agree well with genus otherwise and in color is allied to *H. americanus* Perkins.

Female.—Length, 2.5 mm. Frons subopaque, covered with fine reticulations, frontal line distinct; vertex coriaceous and opaque medianly, shining and almost without sculpture laterally; pronotum shining, very finely granular anteriorly; constricted part of thorax coarsely coriaceous anteriorly, posteriorly with a tendency to become transversely rugulose; anterior part of propodeum shining, almost smooth, the posterior and greater part transversely rugulose; abdomen smooth and shining; body without hair; antennae and forelegs as in figures 3, 4, 5, and 6. Thorax and legs rufo-testaceous; head and abdomen black; head below middle of front, cheeks, and basal antennal joints yellowish.

Paratypes show the fourth tarsal joint of anterior legs slightly longer and the anterior tarsal claws with only three teeth.

Male.—Length, 2. mm. A male bearing the same data as the type female agrees with the figure of the male illustrated in *Das Teirreich* (fig. 49, p. 89). Antennae 10-jointed, as long as the head and thorax, covered with hair, flagellar joints closely united; black, tegulae and legs pale brownish; two basal joints of antenna dark brown; wings hyaline; venation pale brown.

Type locality.—Janjgir, Bilaspur, India. Described from one female reared October 14, 1915, from *Sogata,* species on rice by C. S. Misra.

Paratype locality.—Bilaspur, India. Two females, reared October, 1915, from *Sogata,* species, on rice by C. S. Misra.

Type.—Cat. No. 22383, U.S.N.M. Tag mounted and left foreleg and right antenna on Hym. slide 900. Paratypes tag mounted with a foreleg and antenna on Hym. slides 901 and 898.

PSEUDOGONATOPUS SOGATEA, new species.

Runs fairly satisfactorily to *P. antoxenobius* Perkins in *Das Tierreich* (p. 80) but differs from the original description of that species by being smaller, pronotum not more strongly sculptured than the head and the propodeum is not densely sculptured. If at couplet 3 the propodeum is said to be shining it would go to *nudus* Perkins. but it does not agree with the description of that species.

It is difficult to see the palpi, but I believe that I have seen them correctly; if the maxillary palpi are said to have two joints the species would go to *Paragonatopus,* where it differs in a more concave head. The description of the only species of *Paragonatopus,* however. agrees well with this species.

Female.—Length, 2.5 mm. Labial palpi two-jointed; maxillary palpi four-jointed, the basal joint small, the second somewhat shorter

than the third, the fourth slender style-like; frons shining, with a few setigeous punctures; a faint carina from between bases of antennae to anterior ocellus; ocelli in an acute triangle; vertex subcoriaceous; anterior part of pronotum coriaceous; mesonotum shining, with distinct separate punctures; constricted part of thorax coarsely coriaceous, the area immediately behind transversely rugulose; propodeum subopaque, finely punctured anteriorly, the posterior part transversely rugulose; abdomen, smooth, shining; antennae and anterior legs as in figures 7 and 8. Piceous; face, inner margins of eyes, head behind except at orbits, first three antennal joints yellowish or yellowish-brown; abdomen brownish; legs brownish, coxae paler, femora the darkest brown. Body without pubescence.

Male.—Length, 2 mm. Without much doubt a male, from same locality as the female, belongs here. It is impossible to see the palpi clearly, but the maxillary seem to have only two joints, and other than some specific characters does not seem to differ from male of *Haplogonatopus orientalis* Rohwer. Antennae 10-jointed, as long as head and thorax, rather sparsely clothed with hair, the flagellar joints well separated. Black; first two antennal joints, tegulae and legs testaceous; wings hyaline, venation pale brown.

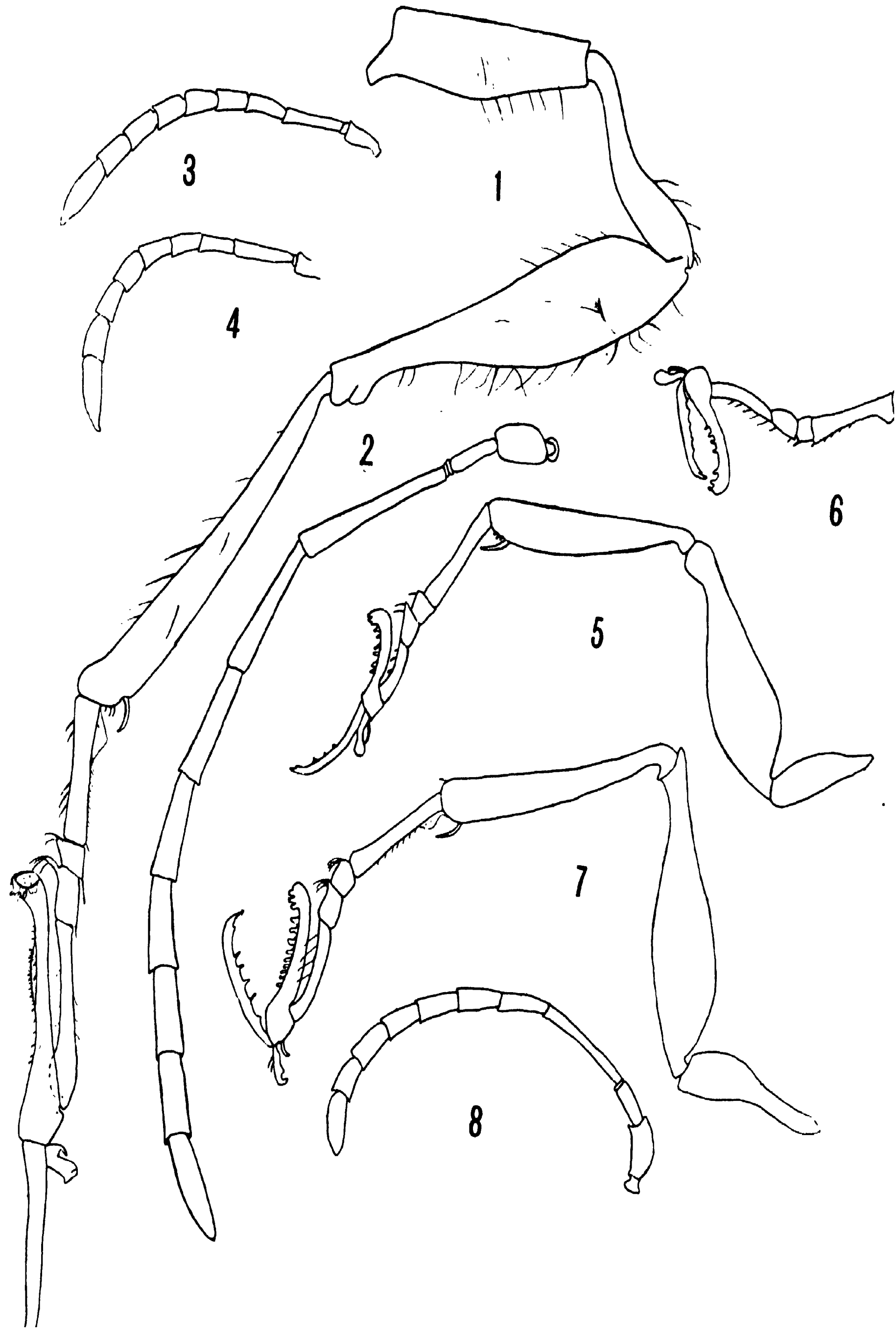
Type locality.—Pusa, Bihar, India. Described from one female, reared August 6, 1915, and one male, reared August 4, 1915, from *Sogata*, species, by C. S. Misra.

Type.—Cat. No. 22382, U.S.N.M. Adult female on pin, the right foreleg and right antenna on Hym. slide 899. Male on pin.

EXPLANATION OF PLATE 22.

All drawings are to the same scale and were made by the author from slides by the use of a Leitz projection apparatus.

Fig. 1.—*Digonatopus lucidus* Rohwer. Anterior leg of female from type.
2.—*Digonatopus lucidus* Rohwer. Antenna from type female.
3.—*Haplogonatopus orientalis* Rohwer. Antenna from type female.
4.—*Haplogonatopus orientalis* Rohwer. Antenna from paratype female.
5.—*Haplogonatopus orientalis* Rohwer. Anterior leg from type female.
6.—*Haplogonatopus orientalis* Rohwer. Anterior tarsi from paratype female.
7.—*Pseudogonatopus sogatae* Rohwer. Anterior leg from type female.
8.—*Pseudogonatopus sogatae* Rohwer. Antenna from type female.



New Species of Indian Drynnid Parasites.

REPORT ON CEPHALOPODS COLLECTED DURING 1906 BY THE UNITED STATES BUREAU OF FISHERIES STEAMER "ALBATROSS" IN THE NORTHWESTERN PACIFIC.

By MADOKA SASAKI,
Of the Fishery Institute, Hokkaido Imperial University.

INTRODUCTION.

The zoological collection made by the United States Bureau of Fisheries steamer *Albatross* during her cruise in the northwestern Pacific in 1906 comprised a large number of specimens of cephalopods. This collection throws much light on the faunal knowledge of that region. The specimens were placed by the aforesaid bureau under the charge of Prof. S. Watase, of the Imperial University of Tokyo, who subsequently handed them over to the writer, who in the meantime, while a student in that university, had begun the monographic study of cephalopods. It is a pleasure to express my thanks to Professor Watase for many courtesies during the progress of the work.

The specimens intrusted to me have been duly examined and are referred to sixty species belonging to twenty-nine genera. Of the sixty species eighteen are new to science. These are listed as follows:

Watasella nigra.
Stauroteuthis albatrossi.
Polypus glaber.
Polypus abruptus.
Polypus ochotensis.
Polypus tsugarensis.
Polypus pustulosus.
Polypus spinosus.
Polypus yendoi.
Polypus alatus.
Polypus tenuipulvinus.
Polypus salebrosus.
Polypus validus.
Rossia mollicella.
Rossia bipapillata.
Sepia carinata.
Gonatopsis octopedatus.
Crystalloteuthis beringiana.

Besides these there are two new varieties, namely, *Polypus macropus*, var. *minor*, and *Sepia kobiensis*, var. *albatrossi*, which are separated from their typical forms for convenience sake, pending a more accurate study based on a greater number of specimens than is accessible to me at present. *Watasella nigra* in the above list is

quite unique in character among cephalopods, though in a few points recalling *Vampyroteuthis infernalis* of Chun, and has obliged the writer to create a new family for it. *Gonatopsis octopedatus* also reveals strong peculiarities, though it has been put under the family Gonatidae. The most remarkable of the peculiarities is the lack of the tentacles, which seems to be well worthy of erecting a new genus for the species.

The species which are reported for the first time from the region under consideration are seven in number, as follows: *Chunella diaphana* (Hoyle), *Scaeurgus patagiatus* Berry, *Mastigoteuthis cordiformis* Chun, *Galiteuthis armata* Joubin, *Taonius pavo* (Lesueur), *Megalocranchia maxima* Pfeffer, and *Liocranchia valdiviae* Chun.

The following is the list of the stations of the dredging operations, showing their position, depth, date, and the species obtained at each:

Station 4760: 53° 53′ N.; 144° 53′ W.; 2,200 fathoms; May 21.......*Gonatus fabricii.*
Station 4763: 53° 46′ N.; 164° 29′ W.; 56 fathoms; May 28..........*Gonatus fabricii.*
Station 4765: 53° 12′ N.; 171° 37′ W.; 1,217 fathoms; May 29. *Gonatus fabricii.* *Crystalloteuthis beringiana.*
Station 4768: 54° 20′ 30″ N.; 179° 09′ 30″ E.; 764 fathoms; June 3.*Galiteuthis armata.*
Station 4769: 54° 30′ 40″ N.; 179° 14′ E.; 244 fathoms; June 3.....*Gonatus fabricii.*
Station 4771: 54° 30′ N.; 179° 17′ E.; 426 fathoms; June 4...*Stauroteuthis albatrossi.*
Station 4772: 54° 30′ 30″ N.; 179° 14′ E.; 372 fathoms; June 4.....*Gonatus fabricii.*
Station 4774: 54° 33′ N.; 178° 45′ E.; 557 fathoms; June 4........*Gonatus magister.*
Station 4775: 54° 33′ 30″ N.; 178° 44′ E.; 584 fathoms; June 4... *Gonatus fabricii.* *Polypus januarii.*
Station 4783: 52° 55′ 30″ N.; 173° 30′ E.; 59 fathoms; June 9. *Crystalloteuthis beringiana.*
Station 4784: 52° 55′ 40″ N.; 173° 26′ E.; 135 fathoms; June 11......*Rossia pacifica.*
Station: Medni Island; June 13..................................*Polypus punctatus.*
Station 4794: 54° 48′ N.; 164° 54′ E.; 2,700 fathoms; June 16, *Polypus punctatus.* *Gonatus fabricii.* *Crystalloteuthis beringiana.*
Station 4796: 52° 47′ N.; 158° 43′ E.; 48 fathoms; June 20.......*Polypus punctatus.*
Station 4797: 52° 37′ 30″ N.; 158° 50′ E.; 682 fathoms; June 20..*Galiteuthis armata.*
Station: Milne Bay, Simushir Island; June 23.....................*Gonatus fabricii.*
Station 4803: 46° 42′ N.; 151° 45′ E.; 229 fathoms; June 24......*Polypus punctatus.*
Station 4806: 42° 13′ N.; 144° 21′ E.; June 26...........*Crystalloteuthis beringiana.*
Station: Hakodate Bay; surface light; June 30, July 12. *Idiosepius pygmaeus.* *Euprymna similis.* *Loligo japonica.* *Sepia andreana.*
Station: Hakodate market; July 1, 2. *Loligo japonica.* *Sepia andreana.* *Euprymna similis.* *Ommastrephes sloani pacificus.*
Station 4807: 41° 36′ 12″ N.; 140° 36′ E.; 44 fathoms; July 16.... *Polypus spinosus.* *Sepiola birostrata.*
Station 4808: 41° 35′ 50″ N.; 140° 36′ 45″ E.; 47 fathoms; July 16. *Polypus conispadiceus.*

Station 4809: 41° 18′ N.; 140° 08′ 40″ E.; 207 fathoms; July 16...*Polypus spinosus.*

Station 4810: 41° 17′ 20″ N.; 140° 07′ E.; 195 fathoms; July 16. *Rossia pacifica.* *Polypus tsugarensis.*

Station 4812: 38° 33′ N.; 138° 40′ E.; 176 fathoms; July 18.........*Rossia pacifica.*

Station 4813: 38° 35′ N.; 138° 41′ E.; 200 fathoms; July 18........*Rossia pacifica.*

Station 4817: 38° 12′ N.; 138° 52′ E.; 61 fathoms; July 18......*Polypus fang-siao.*

Station: Sado Island; surface; date unknown........ *Ommastrephes sloani pacificus.* *Sepiola birostrata.*

Station: Ebisu Market, Sado Island; July 19..........*Ommastrephes sloani pacificus.*

Station 4822: 37° 08′ 10″ N.; 137° 08′ E.; 130 fathoms; July 21......*Rossia pacifica.*

Station 4826: 37° 25′ N.; 137° 32′ E.; 545 fathoms; July 21..........*Rossia pacifica.*

Station 4828: 37° 23′ N.; 137° 36′ E.; 163 fathoms; July 21..........*Rossia pacifica.*

Station 4829: 37° 20′ N.; 137° 41′ 30″ E.; 527 fathoms; July 22. *Watasenia scintillans.*

Station 4834: 36° 03′ 30″ N.; 135° 54′ E.; 130 fathoms; July 23... *Rossia pacifica.* *Sepiola birostrata.*

Station 4835: 36° 03′ 30″ N.; 135° 52′ 30″ E.; 134 fathoms; July 23 *Rossia pacifica.* *Sepiola birostrata.*

Station 4838: 35° 56′ 30″ N.; 153° 39′ 15″ E.; 144 fathoms; July 24 *Rossia pacifica.* *Sepiola birostrata.*

Station 4839: 35° 57′ 45″ N.; 135° 34′ E.; 140 fathoms; July 24..*Sepiola birostrata.*

Station: Tsuruga, Tango Province; shore; July 24................. *Sepia esculenta.* *Sepia kobiensis.*

Station 4843: 36° 29′ 20″ N.; 133° 01′ 20″ E.; 100 fathoms; July 26 *Rossia pacifica.* *Sepiola birostrata.*

Station 4844: 36° 34′ N.; 132° 50′ 20″ E.; 116 fathoms; July 26.. *Rossia pacifica.* *Sepiola birostrata.*

Station 4845: 36° 43′ 30″ N.; 132° 23′ 30″ E.; 550 fathoms; July 26. *Ommastrephes sloani pacificus.*

Station 4852: 36° 06′ 30″ N.; 129° 50′ E.; 568 fathoms; July 30. *Ommastrephes sloani pacificus.*

Station 4853: 36° 08′ N.; 129° 49′ E.; 400 fathoms; July 30......*Gonatus magister.*

Station 4855: 36° 01′ 30″ N.; 129° 42′ E.; 70 fathoms; July 30.. *Watasenia scintillans.* *Ommastrephes sloani pacificus.* *Rossia pacifica.*

Station 4856: 36° 08′ N.; 129° 47′ E.; 300 fathoms; July 30.... *Watasenia scintillans.*

Station 4858: 36° 17′ N.; 129° 40′ E.; 67 fathoms; July 31..........*Rossia pacifica.*

Station 4859: 36° 17′ N.; 129° 41′ E.; 93 fathoms; July 31.... *Watasenia scintillans.* *Rossia pacifica.*

Station 4860: 36° 18′ N.; 129° 44′ E.; 122 fathoms; July 31..........*Rossia pacifica.*

Station 4867: 36° 31′ N.; 129° 46′ E.; 150 fathoms; Aug. 1.... *Watasenia scintillans.*

Station 4868: 36° 32′ N.; 129° 45′ E.; 150 fathoms; Aug. 1...... *Polypus punctatus.* *Rossia pacifica.* *Sepiola birostrata.*

Station 4869: 36° 30′ N.; 129° 42′ E.; 94 fathoms; Aug. 1............*Rossia pacifica.*

Station 4870: 36° 30′ 30″ N.; 129° 43′ E.; 60 fathoms; Aug. 1........*Rossia pacifica.*

Station 4871: 36° 29′ 30″ N.; 126° 43′ 30″ E.; 60 fathoms; Aug. 1...*Rossia pacifica.*

Station 4872: 34° 38′ 30″ N.; 129° 59′ E.; 66 fathoms; Aug. 2.. *Polypus macropus.* *Loligo bleekeri.*

Station 4873: 34° 38′ N.; 130° E.; 66 fathoms; Aug. 2.............*Loligo bleekeri.*

Station 4874: 34° 38′ N.; 130° 03′ E.; 66 fathoms; Aug. 2............*Sepia kobiensis.*

Station 4875: 34° 19′ N.; 130° 09′ E.; 59 fathoms; Aug. 2. *Sepia appellofi.* *Sepia kobiensis*, var. *albatrossi.*

Station 4876: 34° 20′ N.; 130° 10′ E.; 59 fathoms; Aug. 2.......... *Sepia elliptica.* *Sepia kobiensis.*

Station 4878: 34° 18′ 30″ N.; 130° 14′ 30″ E.; 59 fathoms; Aug. 2.
Sepia kobiensis, var. *albatrossi*.

Station: Shimonoseki; date unknown.......................... *Polypus macropus*.

Station: Nagasaki; from fisherman; Aug. 5...................... *Polypus macropus*.

Station 4883: 32° 33′ 30″ N.; 129° 32′ E.; 53 fathoms; Aug. 8....... *Sepia kobiensis*.

Station 4884: 32° 32′ N.; 129° 30′ 45″ E.; 53 fathoms; Aug. 8...... *Sepia appellöfi*. *Sepia kobiensis*.

Station 4885: 32° 31′ 30″ N.; 129° 30′ 15″ E.; 53 fathoms; Aug. 8... *Sepia kobiensis*. *Sepia appellöfi*.

Station 4903: 32° 31′ 10″ N.; 128° 33′ 20″ E.; 139 fathoms; Aug. 10,
Sepiolina nipponensis.

Station 4906: 31° 39′ N.; 129° 20′ 30″ E.; 406 fathoms; Aug. 11.......................... *Chiroteuthis (Chirothauma) imperator*. *Taonius pavo*.

Station: Akune, Satsuma Province; date unknown................ *Polypus parvus*. *Sepia kobiensis*.

Station 4912: 31° 39′ 40″ N.; 129° 30′ E.; 391 fathoms; Aug. 12,
Opisthoteuthis depressa.

Station 4915: 31° 31′ N.; 129° 25′ 30″ E.; 424 fathoms; Aug. 12... *Polypus validus*.

Station 4917: 30° 24′ N.; 129° 06′ E.; 361 fathoms; Aug. 13,
Megalocranchia maxima.

Station 4919: 30° 34′ N.; 129° 19′ 30″ E.; 440 fathoms; Aug. 13,
Opisthoteuthis depressa.

Station 4924: 30° 5′ N.; 130° 21′ 20″ E.; 159 fathoms; Aug. 14.... *Scaeurgus patagiatus*.

Station 4930: 30° 12′ N.; 130° 44′ E.; 84 fathoms; Aug. 15......... *Sepia misakiensis*.

Station 4931: 30° 12′ N.; 130° 43′ 40″ E.; 83 fathoms; Aug. 15,
Sepia kobiensis, var. *albatrossi*.

Station 4933: 30° 59′ N.; 130° 29′ 50″ E.; 152 fathoms; Aug. 16..... *Sepia appellöfi*.

Station 4937: 31° 13′ N.; 130° 43′ 10″ E.; 58 fathoms; Aug. 16....... *Sepia kobiensis*.

Station 4938: 31° 16′ 45″ N.; 130° 43′ 40″ E.; 70 fathoms; Aug. 16. *Sepia elliptica*. *Sepia kobiensis*.

Station 4940: 31° 22′ 10″ N.; 130° 40′ 10″ E.; 115 fathoms; Aug. 17,
Sepiolina nipponensis.

Station 4941: 31° 22′ 10″ N.; 130° 39′ 20″ E.; 117 fathoms; Aug. 17.. *Sepiolina nipponensis*. *Polypus macropus*.

Station 4942: 31° 23′ 10″ N.; 130° 39′ 10″ E.; 118 fathoms; Aug. 17... *Sepiolina nipponensis*. *Polypus macropus*.

Station 4943: 31° 24′ 35″ N.; 130° 38′ 40″ E.; 119 fathoms;
Aug. 17, *Sepiolina nipponensis*.

Station 4946: 31° 29′ 10″ N.; 130° 34′ 30″ E.; 39 fathoms; Aug. 20... *Sepia kobiensis*.

Station 4951: 31° 10′ 30″ N.; 131° 58′ 30″ E.; 703 fathoms; Aug. 21,
Chiroteuthis (Chirothauma) imperator.

Station 4952: 31° 19′ N.; 132° 11′ 30″ E.; 700 fathoms; Aug. 21............................. *Argonauta böttgeri*. (?) *Ommastrephes sloani pacificus*.

Station 4956: 32° 32′ N.; 130° 25′ E.; 720 fathoms; Aug. 23....... *Chunella diaphana*

Station 4957: 32° 36′ N.; 132° 23′ E.; 437 fathoms; Aug. 23... *Enoploteuthis chunii*. *Polypus januarii*. *Polypus punctatus*. *Polypus alatus*.

Station 4960: 32° 34′ N.; 132° 21′ 45″ E.; 578 fathoms; Aug. 23,
Thelidioteuthis alessandrini.

Station 4961: 24° 09′ 15″ N.; 134° 56′ 40″ E.; 33 fathoms; Aug. 27.. *Sepia peterseni*.

Station 4963: 34° 06′ 15″ N.; 134° 57′ 50″ E.; 40 fathoms; Aug. 27.. *Loligo edulis*. *Sepia peterseni*.

Station 4967: 33° 25′ 10″ N.; 135° 37′ 20″ E.; 244 fathoms; Aug. 29. *Rossia mollicella*.

Station 4969: 33° 23′ 40″ N.; 135° 33′ E.; 587 fathoms; Aug. 29 *Opisthoteuthis depressa*. *Polypus abruptus*.

Station 4970: 33° 23′ 30″ N.; 135° 36′ 30″ E.; 500 fathoms; Aug. 30, *Liocranchia valdiviae.*
Station 4972: 33° 25′ 45″ N.; 135° 33′ E.; 440 fathoms; Aug. 30....*Rossia mollicella.*
Station 4973: 33° 24′ 15″ N.; 135° 30′ 30″ E.; 600 fathoms; Aug. 30..*Polypus januarii.*
Station 4977: 33° 23′ N.; 135° 37′ 40″ E.; 544 fathoms; Aug. 31......*Watasella nigra.*
Station 4983: 43° 01′ 35″ N.; 140° 10′ 40″ E.; 425 fathoms; Sept. 19.*Gonatus magister.*
Station 4989: 43° 23′ 10″ N.; 140° 37′ E.; 92 fathoms; Sept. 20......*Rossia pacifica.*
Station 4993: 45° 25′ 30″ N.; 140° 53′ E.; 142 fathoms; Sept. 21.....*Rossia pacifica.*
Station 4994: 45° 27′ 50″ N.; 140° 54′ E.; 190 fathoms; Sept. 22.....*Rossia pacifica.*
Station 5005: 46° 04′ 40″ N.; 142° 27′ 30″ E.; 42 fathoms; Sept. 24.*Polypus macropus.*
Station 5010: 46° 30′ 30″ N.; 142° 43′ 30″ E.; 21 fathoms; Sept. 24..*Rossia pacifica.*
Station 5023: 48° 43′ 30″ N.; 145° 03′ E.; 75 fathoms; Sept. 27..*Polypus ochotensis.*
Station 5026: 48° 36′ 10″ N.; 145° 17′ 30″ E.; 119 fathoms; Sept. 28.*Polypus ochotensis.*
Station 5029: 48° 22′ 30″ N.; 145° 43′ 30″ E.; 440 fathoms; Sept. 28. {*Gonatopsis octopedatus.* *Stauroteuthis albatrossi.* *Polypus salebrosus.*}
Station 5030: 46° 29′ 30″ N.; 145° 46′ E.; 1,800 fathoms; Sept. 29, *Crystalloteuthis beringiana.*
Station 5031: 44° 04′ N.; 145° 32′ E.; 86 fathoms; Sept. 30....... {*Rossia pacifica.* *Sepiola birostrata.*}
Station 5032: 44° 05′ N.; 145° 30′ E.; 300 fathoms; Sept. 30........*Sepiola birostrata.*
Station 5042: 42° 17′ 30″ N.; 142° 07′ 30″ E.; 61 fathoms; Oct. 3..*Rossia pacifica.*
Station 5044: 42° 10′ 40″ N.; 142° 14′ E.; 309 fathoms; Oct. 3......*Polypus glaber.*
Station 5045: 42° 11′ 10″ N.; 142° 12′ E.; 359 fathoms; Oct. 3.......*Polypus glaber.*
Station 5046: 38° 15′ 07″ N.; 141° 44′ 20″ E.; 82 fathoms; Oct. 10.*Sepiola birostrata.*
Station 5047: 38° 12′ 50″ N.; 141° 49′ 15″ E.; 107 fathoms; Oct. 10 {*Rossia pacifica.* *Sepiola birostrata.*}
Station 5048: 38° 09′ 24″ N.; 141° 52′ 30″ E.; 129 fathoms; Oct. 10. {*Watasenia scintillans.* *Rossia pacifica.* *Sepiola birostrata.*}
Station 5049: 38° 12′ N.; 142° 02′ E.; 182 fathoms; Oct. 10......*Watasenia scintillans.*
Station 5050: 38° 11′ 30″ N.; 142° 08′ E.; 266 fathoms; Oct. 10. {*Stauroteuthis albatrossi.* *Polypus glaber.* *Polypus salebrosus.* *Sepiola birostrata.*}
Station 5051: 38° 11′ N.; 142° 12′ E.; 399 fathoms; Oct. 10.........*Rossia mollicella.*
Station 5053: 34° 49′ 20″ N.; 138° 40′ 15″ E.; 503 fathoms; Oct. 12..*Polypus glaber.*
Station 5055: 34° 53′ N.; 138° 44′ 15″ E.; 124 fathoms; Oct. 12.*Sepiolina nipponensis.*
Station 5060: 35° 06′ N.; 138° 40′ 10″ E.; 197 fathoms; Oct. 13. *Mastigoteuthis cordiformis.*
Station: Shimizu, Suruga Province; shore; Oct. 14............. {*Euprymna morsei.* *Sepia kobiensis.* *Polypus macropus.*}
Station: Shimizuminato; Oct. 15..*Polypus parvus.*
Station 5069: 35° 03′ 10″ N.; 138° 47′ E.; 131 fathoms; Oct. 15 {*Rossia bipapillata.* *Sepiolina nipponensis.*}
Station 5074: 34° 40′ 45″ N.; 138° 18′ 30″ E.; 47 fathoms; Oct. 16. *Polypus macropus*, var. *minor.*
Station 5081: 34° 15′ N.; 138° 05′ E.; 500 fathoms; Oct. 19........*Argonauta hians.*
Station 5082: 34° 05′ N.; 137° 59′ E.; 662 fathoms; Oct. 20...*Stigmatoteuthis dofleini.*
Station 5084: 34° N.; 137° 49′ 40″ E.; 918 fathoms; Oct. 20..*Stauroteuthis albatrossi.*
Station 5092: 35° 04′ 50″ N.; 139° 38′ 18″ E.; 70 fathoms; Oct. 26. {*Opisthoteuthis depressa.* *Polypus pustulosus.* *Polypus tenuipulvinus.* *Sepia carinata.*}
Station 5094: 35° 04′ 42″ N.; 139° 38′ 20″ E.; 88 fathoms; Oct. 26....*Sepia carinata.*
Station 5095: 35° 05′ 34″ N.; 139° 38′ 36″ E.; 58 fathoms; Oct. 26... {*Sepia kobiensis.* *Sepia appellöfi.*}

DESCRIPTION OF SPECIES.

Suborder OCTOPODA Leach.

Division LIOGLOSSA Lütken.

WATASELLIDAE, new family.

WATASELLA, new genus.

1. WATASELLA NIGRA, new species.

Plate 23, fig. 1.

Station 4977 (off Kii Province). One specimen.

Animal soft, choroidal, translucent, covered by a flabby and smooth skin throughout. Mantle thick, saccular, a little longer than broad, widest anteriorly, rounded posteriorly. Mantle-opening wide, extending half round the body. Fins, two pairs in number, those of each pair attached side by side to the dorso-lateral surface of the mantle much nearer to its posterior end than to the anterior margin; the line of attachment being longitudinal. Transverse length of fins equal to about twice their breadth and a quarter of the length of the mantle.

Head large, subcylindrical, as broad as the body, with no constriction in front or behind. Eyeball dark violet in color, opening on the exterior through a large orifice. Tuberculus olfactorius of pink color, present on each side of the neck region a little before and below each angle of mantle-opening.

Arms subequal, on an average about as long as the head and mantle taken together; cylindrical in the proximal half, then tapering distad to the attenuated extremities. Umbrella thick, broad, extending half way up the arms, apparently without nodule at the termination of its attachment. The suckers number ten or more in each arm, set uniserially on its distal half; globular but depressed at the distal end, which has a minute aperture at the center; deeply constricted at base so that they approach in appearance the pedunculate suckers of decapods. Cirri biserial, alternating with the suckers, but ten or twelve more are found proximal to the first sucker on each arm.

A tubular pouch exists between the first and second arms on either side, running radially through the umbrella, and opening externally on the umbrella edge. The pouch has a filamentous organ growing from its blind end.

Beak strong, very large. Radula not examined.

Color of inner surface of umbrella in formalin, quite black; external surfaces of all parts apparently also of the same color, except the mantle edge, which is of reddish hue. Tuberculus olfactorius, inner and outer lips, the distal part of suckers and cirri all of a light crimson.

Total length 25 mm.; ventral length of mantle 8.3 mm.

Type.—Cat. No. 332892, U.S.N.M.

Family CIRROTEUTHIDAE Keferstein.

Genus STAUROTEUTHIS Verrill.

Plate 23, figs. 2, 3.

2. STAUROTEUTHIS ALBATROSSI, new species.

Station 4771 (Bering Sea). One female. Cat. No. 332950, U.S.N.M.

Station 5029 (Okhotsk Sea). One young female. Cat. No. 332951, U.S.N.M.

Station 5050 (off Kinka-san). One male. Cat. No. 332949, U.S.N.M.

Station 5084 (off Totomi Prov.). One female. Cat. No. 332948, U.S.N.M.

Animal very soft, choroidal, flabby, bell-shaped, without clear outward demarkations between head, body, and arms. Body hemispherical, quite rounded behind and never flattened. Mantle opening very narrow, crescentiform, its margin fitting closely around the tubular part of the funnel. Fins transverse-ovate with their antero-distal margin rounded, and their posterior margin nearly straight; attached to the dorso-lateral surface of the mantle to a little in front of half their length. Length of fins two-thirds their width.

Head broader than body. Eyes full, diameter of eyeball one-third of the breadth of the head. Tuberculus olfactorius present on the base of the funnel near each angle of the mantle-cavity. Funnel sunk deeply in the mantle-cavity. Umbrella very broad, as thick as the arms; radii about equally long but those between the first arms and between the first and second arms a little longer than those of the other interbrachial spaces, measuring over half the length of these arms.

Arms soft, greatly elastic, seemingly about uniform, and about twice as long as the head and body taken together. Suckers 70–90 in each arm; uniserial. They begin with a minute sucker at the base of the arms, becoming quickly larger to the six or seventh, then very gradually diminishing in size toward the extremity. Cirri in two opposite series, alternating regularly with the suckers, beginning proximally between first and second suckers. Both dorsal arms hectocotylized, provided with three very conspicuous suckers halfway along their length.

Dorsal cartilage U-shaped; the horns turning cephalad and tapering to sharp points; the middle part transverse, forming an obtuse angle in the middle. Section of the cartilage crescentic, the convexity turning anteriorly and internally. Concave posterior surface of each horn separated from that of the middle part by a vertical ridge.

Inner surfaces of umbrella and arms colored deep purple, which sometimes deepens into quite black, but the suckers are always of

a little lighter tint and more reddish. External surface of all parts appears light reddish brown in color.

Ink-gland absent. Gills massive, each with eight lobular leaflets. Oviduct and water vascular canal both single, namely those of the left side. Vagina stout, projecting freely into mantle-cavity. Mature ovarian eggs 10 mm. long.

Total length 40–200 mm.

Type-locality.—Off Kinka-san, Rikuzen Province.

Type.—Cat. No. 332949, U.S.N.M.

Genus OPISTHOTEUTHIS Verrill.

3. OPISTHOTEUTHIS DEPRESSA Ijima and Ikeda.

Opisthoteuthis depressa IJIMA and IKEDA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 8, 1895, pp. 1–15, pl. 33.—MEYER, Zool. Anz., vol. 29, 1906, pp. 758–760; Zeitsch. wiss. Zool., vol. 75, 1906, pp. 183-269, pls. 11–16.—MARCHAND, Zeitsch. wiss. Zool., vol. 86, 1907, p. 381.—DOLLO, Zool. Jahrb. Suppl., vol. 15, 1912, pp. 131, etc., pl. 3, fig. 5.

Station 4912 (off Satsuma Prov.). Two females. Cat. No. 332941, U.S.N.M.

Station 4969 (off Kii Prov.). One female. Cat. No. 332943, U.S.N.M.

Station 4919 (off Kusakaki-jima). One female. Cat. No. 332942, U.S.N.M.

Station 5092 (Sagami Sea). One female. Cat. No. 332940, U.S.N.M.

The specimens listed above are, without hesitation, referred to the present species; they are not, however, so much flattened as described by Ijima and Ikeda but show a concavo-convex curvature or even a shallowly urceolate structure, approaching *Stauroteuthis* in shape, and the dorsal cartilage is not straight, but bent into a crescent.

Division TRACHYGLOSSA Lütken.

Family ELEDONELLIDAE, new name.

Bolitaenidae CHUN, Cirrothauma, 1911, p. 20.—NAEF, Teutholog. Notiz., vol. 8, 1912, p. 196.—BERRY, Hawaiian Cephalopoda, 1914, p. 289.

Genus CHUNELLA, new name.

Bolitaena CHUN, Cirrothauma, 1911, p. 17.

Japettella (part) HOYLE, Ann. Mag. Nat. Hist., ser. 5, vol. 15, 1885, p. 232.

Eledonella HOYLE, *Challenger* Cephalopoda, 1886, p. 106.

Chun (1911) mentions a specimen caught by the *Valdivia* under the name of *Bolitaena diaphana*, identifying it with *Eledonella diaphana* (Hoyle), without giving any explanation for the reason why he refers it to the genus *Bolitaena*. Judging from Steenstrup's description reproduced in Hoyle (1886, p. 16), that genus seems closely related to *Alloposus*, a quite different genus from Verrill's *Eledonella* (not Hoyle's).

Type.—*Chunella diaphana* (Hoyle), 1885.

4. CHUNELLA DIAPHANA (Hoyle).

Japetella diaphana Hoyle, Ann. Mag. Nat. Hist., ser. 5, vol. 15, 1885, p. 232.
Eledonella diaphana Hoyle, *Challenger* Cephalopoda, 1886, p. 107, pl. 9, figs. 3–6.—Joubin, *Princess-Alice* Cephalopoda, 1900, p. 37, pl. 2, figs. 5–7.—Hoyle, *Albatross* Cephalopoda, 1904, p. 22. pl. 5, fig. 11.
Bolitaena diaphana Chun, Cirrothauma, 1911, pp. 15–20; figs. 7, 8.

Station 4956 (off Kii Province). An immature specimen. Cat. No. 332924, U.S.N.M.

This specimen agrees well with Hoyle's description. As compared with Chun's illustration the optic ganglion is a little too broad, and the optic nerve slender, but no difference otherwise could be made out.

Family ARGONAUTIDAE Cantraine.

Subfamily ARGONAUTINAE Berry.

Genus ARGONAUTA Linnaeus.

5. ARGONAUTA HIANS Solander.

Argonauta hians Férussac and d'Orbigny, Céphalopodes acétabulifères, 1838, p. 174, pl. 5.—Gray, British Museum, 1849, p. 33.—Tryon, Manual Conchology, vol. 1, 1879, p. 136, pl. 46, figs. 100-102.—Ortmann, Japanische Cephalopoden, 1888, p. 641.—Hoyle, *Albatross* Cephalopoda, 1904, p. 11.

Station 5081 (Yenshu-nada). One young female. Cat. No. 332952, U.S.N.M.

6. ARGONAUTA BÖTTGERI Maltzan.

Argonauta böttgeri Smith, Ann. Mag. Nat. Hist., ser. 5, vol. 21, 1887, p. 409, pl. 17, figs. 1–6.—Dall, *Albatross* Report, 1908, pp. 226, 229.—Berry, Hawaiian Cephalopoda, 1914, pp. 277–280, textfigs 3–7, pl. 48, fig. 5.—Massy, Antarctic Expedition Report, 1916, p. 143, textfigs. 1, 2.

Station 4952 (east of Osumi Prov.). Two females. Cat. No. 332953, U.S.N.M.

Of the said two specimens the larger approaches *A. hians* in that the ribs of the shell are relatively few, and the granules on its sides comparatively rare. As compared with Berry's illustration, the pads of the funnel organ are narrower. The smaller specimen is very small, the shell measuring only 25 mm. in length, yet it bears already egg-clusters within the shell; which seems to be a characteristic of the species so far as I have been able to ascertain.

Family POLYPODIDAE Hoyle.

Genus POLYPUS Schneider.

7. POLYPUS PAVUS Sasaki.

Polypus parvus Sasaki, Annot. Zool. Japon., vol. 9, 1917, p. 365.

Station Akune, Satsuma. One female. Cat. No. 332964, U.S.N.M.

Station Shimizuminato Two females and males. Cat. 332965, U.S.N.M.

These specimens are all fully mature and measure 110–145 mm. in length. They agree in every respect with the original specimens, and there is no need to add further details to what has been said about the species.

8. POLYPUS FANG-SIAO (d'Orbigny).

Octopus fang-siao D'ORBIGNY, in Férussac and d'Orbigny, Céphalopods acétabulifères, 1838, p. 71.

(?) *Octopus areolatus* DE HAAN MS. in Férussac and d'Orbigny, Céphalopodes acétabulifères, 1838, p. 65.

Octopus ocellatus GRAY, Brit. Mus. Cat., 1849, p. 15.—JOUBIN, Notes Leyden Museum, vol. 20, 1898, p. 22.

Polypus areolatus (part) WÜLKER, Doflein Beitr. Naturgesch. Ostasiens, 1910, p. 6.—Berry, Japanese Cephalopoda, 1912, p. 393.

Station 4817 (off Niigata). Two juvenile specimens. Cat. No. 332966, U.S.N.M.

These two specimens measure 6 mm. and 4.5 mm. in mantle-length respectively. For such young, they show already the characteristic ocellar patch in front and below each eye and the elongated patch above the head between the eyes. The five circumorbital cirri are also well discernible.

9. POLYPUS JANUARII (Steenstrup).

Octopus januarii HOYLE, *Challenger* Cephalopoda, 1886, p. 97, pl. 7, figs. 1–4.—GOODRICH, Calcutta Museum Collection Report, 1896, p. 19.

Polypus januarii HOYLE, *Albatross* Cephalopoda, 1904, p. 18, pl. 5, fig. 2.—BERRY Japanese Cephalopoda, 1912, p. 392.

Station 4775 (Aleutian Island). One young female. Cat. No. 332974, U.S.N.M.

Station 4957 (Bungo-suido). One female, badly mutilated. Cat. No. 332975, U.S.N.M.

Station 4973 (off Kii Province). One young female. Cat. No. 332973, U.S.N.M.

The specimens alluded to seem to me properly referable to the present species. But their heads are by no means as small as stated by Hoyle (1886), being as broad, or even broader, than the body. In other respects they differ from his illustration (1904); as for instance, the inner lateral teeth of the radula have a broad base and a faint blunt cusp on the inner side in addition to the sharp ordinary cusp on the outer.

10. POLYPUS GLABER, new species.

Station 5044 (Hokkaido). One young female. Cat. No. 332980, U.S.N.M.

Station 5045 (Hokkaido). One young male. Cat. No. 332981, U.S.N.M.

Station 5050 (off Kinka-san). One young female. Cat. No. 332982, U.S.N.M.

Station 5053 (Suruga Bay). One young female. Cat. No. 332983, U.S.N.M.

Skin more or less choroidal in consistency, quite smooth throughout, even around eyes. Body slightly broader than long, expanded posteriad, provided with a shallow median groove on the belly, and a distinct horizontal ridge around the periphery. Mantle opening narrow.

Head slightly narrower than body; neck quite feebly constricted. Funnel organ W-shaped, its median Λ-shaped part twice as long as the outer limbs. Umbrella rather narrow, of nearly equal breadth all round.

Arms subequal, the formula of length being $1>2>3=4$; longest pair three to four times as long as body. Suckers small, arranged in two well-defined rows, except three or four at the base of the arms, which are in a zigzag row. The ninth or tenth sucker is the largest though not specially enlarged. Right third arm hectocotylized, a little shorter than the left third; terminal organ $\frac{1}{20}$ the entire length, subfusiform, provided with narrow but well-defined copulatory groove and about 22 distinct transverse streaks; suckers 52 pairs on the normal part.

Penis rather small, its posterior half bent almost into the shape of a C, the anterior origin of which is connected with L-shaped Needham's sac. Vaginae and oviducts proper, both nearly straight, the former terminating far behind the anus.

Gill composed of 23 or 24 leaflets. Caecum of stomach spherical, but little flattened dorsoventrally and slightly involute. No ink-gland present.

Total length, 245 mm. in male, 155–185 mm. in female.

Type locality.—Off Hidaka Province, Hokkaido.

Type.—Cat. No. 332981, U.S.N.M.

11. POLYPUS ABRUPTUS, new species.

Station 4969 (off Kii Province). One male and female. Cat. No. 332935, U.S.N.M.

Surface quite smooth, rather firm to the touch. Body as long as, or longer than, broad; without distinct horizontal ridge along the periphery. Mantle opening of moderate breadth.

Head a little narrower than body, separated from it by a weak constriction. Umbrella broad, equally developed all around, extending about a quarter up the arms to the fourteenth or fifteenth pair of suckers, then continuing on as a rather broad contractile membrane along the ventral side of the arms to the extremity. Funnel organ conspicuous, situated in the middle of dorsal funnel-wall, W-shaped, the outer limbs half as long as the Λ-shaped central part.

Arms subequal, the formula of length being $1>2=3=4$; first pair about four times as long as the head and body taken together. Suckers

85–90 pairs on each arm, closely set in two well-defined rows excepting several at base which are sparsely arranged in one zigzag, or two alternating rows. They are very unequal in size and increase rapidly to the fourteenth or fifteenth pair on each arm, beginning with a minute sucker at base. The fifteenth to the seventeenth pair which are opposite to the umbrella edge, are markedly enlarged, and succeeded by several pairs of quickly diminishing suckers; beyond these they become smaller very gradually and uniformly toward the extremity.

Right third arm hectocotylized, about four-fifths as long as the left third; terminal organ slender conic, occupying one-thirteenth of the entire length and provided with a distinct copulatory groove. Suckers on the normal part 57 pairs.

Gill composed of 21–23 branchial leaflets.

Penis fusiform, 25 mm. long, connected with the duct of Needham's sac at a point one-third the length from the distal end. Spermatophores about 90 mm. long.

Vaginae thick, short terminating for behimd the anus.

Total length 52 cm. in male, 39 cm. female.

Type.—Cat. No. 332935*a*, U.S.N.M.

12. POLYPUS OCHOTENSIS, new species.

Station 5023 (near Cape Patience, Okhotsk Sea). One female. Cat. No. 332955, U.S.N.M.

Station 5026 (Taraika Bay). One young male. Cat. No. 332956, U.S.N.M.

Superficial texture loose, soft and flabby. Surface quite smooth, or with a few warts. Three unequal cirri are present above each eye. Body globose, as long as wide, provided with a distinct horizontal ridge around periphery, but with no median groove on belly. Mantle opening of moderate width.

Head large. Neck constriction not marked. Umbrella well-developed, extending $\frac{1}{3}$–$\frac{1}{4}$ up the arms and thereafter continued as a narrow contractile membrane along the ventral side to the extremity. Funnel incorporated with head excepting a short conical extremity. Funnel organ W-shaped, the ∧-shaped middle part slightly longer than twice the length of outer limbs.

Arms nearly uniform in length and a little longer than three times the mantle length. Suckers rather small, arranged in two well-defined rows excepting the first three or four which are in a zigzag row. None of suckers specially enlarged. Right third arm hectocotylized, its terminal organ $\frac{1}{25}$ the entire length; suckers on the normal part 42 pairs.

Gill composed of 18 or 19 leaflets. Ink gland present. Ovary markedly expanded sideways, its eggs about 9 mm. long, numbering 33. Oviducts proper situated to the right of their usual position.

Vaginae very thick, short, terminating far behind the anus. Penis only 5 mm. long, spindle-shaped, the swollen middle part connected with Needham's sac.

Total length 190 mm. in female, about 95 mm. in male.

Type locality.—Near Cape Patience, Okhotsk Sea.

Type.—Cat. No. 332955, U.S.N.M.

13. POLYPUS TSUGARENSIS, new species.

Plate 23, fig. 4.

Station 4810 (Tsugaru Strait). One mature male. Cat. No. 332972, U.S.N.M.

Animal fleshy, very firm to the touch. Surface smooth excepting a number of faint warts irregularly distributed about the eyes. A laterally flattened cirrus is present above each eye. Body compact, broader than long, expanded posteriorly. Mantle opening of moderate width.

Head a little narrower than body. Neck constriction weak. Umbrella well developed, especially between the first and second arms as well as between the lateral arms, where it extends more than a quarter up the arms. Funnel rather long. Funnel organ half as long as the distance between the anus and the end of the funnel, situated much nearer to the former than to the latter; trilobate, the lobes all triangular, sharply pointed distally, turning cephalad, and the median lobe decidedly longer than the remaining two. Posterior margin of the organ with a small triangular indentation in the middle.

Arms nearly equal, about four times as long as the body. Suckers arranged in two well-defined rows except at the base of arms where they are set somewhat distantly in two alternating rows. They are markedly unequal, especially in the dorsal arms, where about two pairs near the umbrella margin are characteristically enlarged.

Right third arm hectocotylized, eight-ninths as long as the left third. Terminal organ conical, one-eleventh the entire length of the arm, provided with a well-defined copulatory groove which has distinct transverse striations. The suckers on the normal part 42 pairs.

Penis slender, 11 mm. long, bent crescentwise, connected with the duct of Needham's sac in advance of the middle. Needham's sac slender, bent into the shape of an L. Spermatophoric gland coils in company with its accessory gland. Spermatophores 52 mm. long.

Gill composed of 19 leaflets. Caecum of stomach reniform.

Color in alcohol uniformly reddish brown. Three obscure transverse stripes of a deeper shade are perceptible at the frontal region of head.

Total length 145 mm.; ventral length of mantle 25 mm.

Type.—Cat. No. 332972, U.S.N.M.

14. POLYPUS PUSTULOSUS, new species.

Plate 23, fig. 5.

Station 5092 (Sagami Sea). One female. Cat. No. 332976, U.S.N.M.

Superficial consistency soft, very loose, flabby. Dorsal surface uniformly and rather sparsely covered with minute warts. In addition to these there are found 20 or more, rather large, rounded regularly arranged tubercles. Above each eye are found two cirri, of which the posterior is the larger. Body as wide as long, with neither horizontal ridge around the periphery nor longitudinal groove on the belly. Mantle opening narrow.

Head broad, only a little narrower than the body. Umbrella of moderate breadth, generally extending a quarter up the arms. Funnel organ conspicuous, longer than half the distance between the anus and the end of the funnel, roughly W-shaped. The Λ-shaped middle part of the W is composed of a broader ribbon than the outer limbs, while the anterior turned points are all rounded and the posteriorly turned points are both acuminate.

Arms unequal, the formula of length $1 > 2 > 3 > = 4$ the longest being about three times as long as the head and body taken together. All thick, provided with a broad thick contractile web on the ventral side. Suckers relatively large, distinctly biserial, excepting several at the base of the arms, which are distantly spaced in two alternating rows. None of the suckers specially enlarged on any arm.

Ink-bag large, pyriform. Proximal part of ink-duct sunk deep in the liver. Anal valves rather large. Caecum of the stomach large, hemispherical, slightly involute. Gill composed of 21 leaflets.

Vaginae slender, nearly straight, their distal ends separated from the anus by the length of the gill.

Color in formalin uniformly drab, but a little lighter beneath.

Total length 380 mm.; ventral length of mantle 63 mm.

Type.—Cat. No. 322976, U.S.N.M.

15. POLYPUS CONISPADICEUS Sasaki.

Polypus conispadiceus Sasaki, Annot. Zool. Japon, vol. 9, 1917, p. 367.

Station 4808 (Tsugaru Strait). Two males. Cat. No. 323986 U.S.N.M.

These two specimens are unhesitatingly referred to the present species but the suckers are, on the whole, larger, more expanded distally, and more closely set, than in the type specimen. Moreover, on each arm the suckers become rapidly larger to the eighth or ninth pair, succeeded by three or four pairs of still larger suckers, these are followed by about five pairs of suckers rapidly diminishing in size. Beyond these, the suckers become gradually smaller towards the

extremity of the arms. Of the two specimens the larger, which is 420 mm. in length, has in Needham's sac 22 spermatophores measuring 95 mm. in length, while the smaller, measuring 350 mm. in length, has no spermatophore anywhere.

16. POLYPUS HONGKONGENSIS Berry.

Octopus punctatus GABB, Proc. California Acad. Nat. Sci., vol. 2, 1862, p. 170 (not *O. punctatus* Blainville 1826).—DALL, Proc. California Acad. Nat. Sci., vol. 3, 1866, p. 243, fig. 27.

Polypus hongkongensis BERRY, Bull. Bureau Fish., vol. 30, 1912, p. 280, pl. 35, fig. 3; pl. 36, fig. 1; pl. 39, figs. 3, 4; pl. 40, fig. 1.

Polypus apollyon BERRY, Proc. Acad. Nat. Sci. Phila., 1913, p. 72, fig. 1.

Station Medni. One young. Cat. No. 332994, U.S.N.M.

Station 4777 (near Tanaga Island, Aleutian Islands). Two juv. Cat. No. 332997. U.S.N.M.

Station 4784 (near Near Island, Aleutian Islands). One female and one juv. Cat. No. 332994, U.S.N.M.

Station 4796 (near Shumagin Island). One juv. Cat. No. 332998, U.S.N.M.

Station 4803 (near Shimushir). Three juv. Cat. No. 332995, U.S.N.M.

Station 4868 (near Cape Clonard, Korea). One female. Cat. No. 332993, U.S.N.M.

Station 4957 (Hyuga-nada). Four specimens. Cat. No. 332992, U.S.N.M.

A male specimen from station 4957, which, though only 71 cm. long, is already mature enough to produce spermatophores, is referred with great hesitation to the present species. The warts on the surface are conical, roundish, and not continuous with one another at base as in other specimens. The suckers on each arm become rapidly larger to the eighth pair; then there come about four pairs of markedly enlarged suckers, which are in their turn succeeded by five or six pairs of rapidly diminishing suckers. The suckers on the hectocotylized arm number only 41 pairs, being several pairs fewer than in the ordinary form.

17. POLYPUS SPINOSUS, new species.

Plate 24, fig. 1.

Station 4807 (off Hakodate, Tsugaru Strait). One female. Cat. No. 332967, U.S.N.M.

Station 4809 (off Fukuyama, Tsugaru Strait). One female. Cat. No. 332968, U.S.N.M.

Surface somewhat thickly and evenly beset with comparatively large firm spinous warts with stellate bases. A single low warted cirrus is present above each eye. Body relatively large, without a keel

around the periphery. Mantle opening narrow, extending less than half around the body.

Head slightly narrower than body, weakly constricted behind. Umbrella well developed and continued along the ventral side of the arms to the extremity as a broad contractile web. Funnel rather short. Funnel organ, W-shaped, the middle Λ-shaped part a little longer than the outer limbs.

Arms subequal; lateral pairs slightly longer than the others and about thrice as long as the body. Suckers small, relatively uniform, distinctly biserial but the first three are in a zigzag row.

Branchial leaflets 21 or 22 in each gill. Vaginae only slightly crooked; its freely projecting part only 1 mm. long, decidedly shorter than the renal papillae, and distant from the anus by the length of the gill.

Measurements of type: total length 85 mm.; ventral length of mantle 18 mm.; longest arm 55 mm.; longest radius of umbrella 18 mm.; diameter of largest sucker 1.8 mm.

Type-locality.—Off Fukuyama, Tsugaru Strait.

Type.—Cat. No. 332968, U.S.N.M.

18. POLYPUS LONGISPADICEUS Sasaki.

Polypus longispadiceus SASAKI, Annot. Zool. Japon., vol. 9, 1917, p. 366.

Station 4867 (near Cape Clonard, Korea). One mature male. Cat. No. 332984, U.S.N.M.

Station 4957 (Hyuga-nada). One mature male. Cat. No. 332985, U.S.N.M.

These specimens are referred with great doubt to the present species. In the specimen from the station 4867 the body has a distinct peripheral keel which is not found in the original specimens. The suckers are not relatively uniform but unequal, those near the umbrella margin being markedly enlarged on the first and second arms. In Needham's sac were found 48 spermatophores which are 89 mm. long and 1.2 mm. thick at the aboral end and 0.3 mm. thick at the oral, the sperm cord coiling about 150 turns. The principal measurements of the specimen are as follows: eye to posterior end of body 50 mm.; ventral length of mantle 42 mm.; breadth of either body or head 47 mm.; length of right first arm 185 mm.; of right second arm 181 mm.; of right third and fourth arm 178 mm.; length of hectocotylus 18 mm.; diameter of largest sucker on first arm 12 mm.; on second arm 11.5 mm.; on third arm 8 mm.; on fourth arm 6.5 mm.

In the specimen from the station 4957, the hectocotylized arm is a little shorter than the corresponding arm of the opposite side. The umbrella is broadest between the dorsal arms. The penis is 35 mm. long, but bent almost into the shape of a Z, and expanded near the middle. The spermatophoric gland coils and is folded in a manner different from that of the original specimens. Principal measure-

ments: eye to posterior end of body 65 mm.; ventral length of mantle 55 mm.; breadth of body 53 mm.; breadth of head 48 mm.; length of first arms about 280 mm.; of second arms 270 mm.; of left third arm 248 mm.; of right third arm 240 mm.; of right fourth arm 240 mm.; diameter of largest sucker on first and second arm 15 mm.; on third arm 13 mm.; on fourth arm 11 mm.

19. POLYPUS YENDOI, new species.

Plate 24, fig. 2.

Station 4844 (near Oki Island, Krusenstern Strait). One male and female. Cat. No. 332990, U.S.N.M.

Station 4855 (near Cape Clonard, Korea). Six males and five females. Cat. No. 332987, U.S.N.M.

Station 4858 (near Cape Clonard, Korea). One female. Cat. No. 332988, U.S.N.M.

Station 4868 (off Yon-hai, Korea). One female. Cat. No. 332989, U.S.N.M.

Station 5804 (off Kinka-san). One male and female. Cat. No. 332991, U.S.N.M.

Consistency soft, somewhat flabby. Skin loose. Dorsal surface sparsely beset with well-marked roundish warts of various sizes, their thickest distribution being above and behind eyes. No cirri above the eyes. Body about as broad as long, widest about the middle or a little posterior to it; belly nearly flat, sometimes forming a faint longitudinal groove in the middle; periphery bordered with a distinct horizontal ridge all around. Mantle opening narrow, extending a little less than half around the body.

Head large, only a little narrower than the body, more distinctly marked off anteriorly than posteriorly, with somewhat prominent eyes. Umbrella well developed, broadest between ventral arms. Funnel extensively incorporated with head, the freely projecting part being very short. Funnel organ W-shaped, the median Λ-shaped part far longer than the outer limbs.

Arms subequal, the formula of length being $1>2>3=4$; the longest about four times the body-length. Suckers rather small, sparsely biserial throughout. The largest suckers on each arm are the ninth to eleventh pair which are opposite the umbrella edge, and frequently show a special enlargement on the first and second arms. Right third arm hectocotylized, decidedly shorter than the left third. Full-formed terminal organ about one-thirteenth the entire length of the arm; its copulatory groove well-defined and marked by numerous transverse streaks. The suckers on this arm number 49–52 pairs.

Gill composed of 21 or 22 leaflets. Full-formed ovary very large; its eggs also conspicuous, measuring 17 by 7 mm. Vaginae thick, short, terminating far behind the anus. Full-formed penis about

25 mm. long, elongated, nearly straight, devoid of diverticle. Spermatophores about 90 mm. long, their opaque part 25–28 mm. long, consisting of 110 by 120 coils of sperm cord.

Total length up to 262 mm. in male, and 290 mm. in female.

Type locality.—Near Cape Clonard, Korea.

Type.—Cat. No. 332987*a*, U.S.N.M.

20. POLYPUS ALATUS, new species.

Plate 24, fig. 4.

Station 4957 (Bungo-suido). One mature male. Cat. No. 332978, U.S.N.M.

Station, unknown. One immature male. Cat. No. 332979, U.S.N.M.

Surface quite smooth, somewhat firm to the touch. Body compact, broadest posteriorly, bordered with a horizontal ridge along periphery. Mantle-opening narrow, extending less than half around the body. Umbrella well developed, on an average extending for about one-fourth the length of arms, and then continuing along the ventral side almost to the extremity as a broad fleshy contractile web. Funnel slender, well defined. Funnel organ small, W-shaped.

Arms very unequal, the formula of length being $1>2>3>4$; the longest about five times the length of head and body taken together. Suckers small, low, closely arranged in two well separated rows excepting several proximal ones which are in a single straight or zigzag row.

Right third arm hectocotylized, three-fourths as long as the left third, bearing 40–45 pairs of suckers on the normal part. Terminal organ roughly conical, comparatively thick and short, comprising a little less than $\frac{1}{20}$ the entire length of the arm.

Penis elongated, fusiform, broadest in advance of the middle where it is connected with the duct of the L-shaped Needham's sac. Spermatophores 48 mm. long, very thin excepting the aboral end which is markedly swollen.

Gill composed of 22 leaflets. Caecum of the stomach elliptical in outline, a little involute.

Measurements of type; total length 440 mm.; ventral length of mantle 55 mm.; longest arm 340 mm.; hectocotylized arm 190 mm.; longest radius of umbrella 80 mm.; diameter of largest sucker 5 mm.

Type-locality.—Bungo-suido.

Type.—Cat. No. 332978, U.S.N.M.

21. POLYPUS MACROPUS Risso.

Octopus macropus Hoyle, *Challenger* Cephalopoda, 1886, pp. 11, 95.—Ortmann, Japanische Cephalopoden, 1888, p. 643, pl. 21, fig. 3. — Joubin, Bull. Soc. Zool. France, vol. 22, 1897, p. 99.

Octopus cuvieri Appellöf, Japanska Cephalopoder, 1886, p. 6, pl. 1, fig. 6.

Polypus macropus Wülker, Doflein Beitr. Naturgesch. Ostasiens, 1910, p. 8.—Berry, Japanische Cephalopoda, 1912, p. 389.

Station 4872 (east of Tsushima). One juv. specimen. Cat. No. 332960, U.S.N.M.

Station 5005 (Sakhalin). One immature male. Cat. No. 332962, U.S.N.M.

Nagasaki. One immature male. Cat. No. 332958, U.S.N.M.

Shimonoseki. One immature female. Cat. No. 332957, U.S.N.M.

Station 4942 (off Osumi). One immature female. Cat. No. 332961, U.S.N.M.

Shimizu, Suruga. One male. Cat. No. 332959, U.S.N.M.

These specimens are referred with a great deal of hesitation to *Polypus macropus*, although they agree in most particulars with the descriptions of the authors consulted. On the whole I have much doubt whether the species extends as far as the Japanese waters from its home; that is, the Mediterranean Sea. As far as I have examined, indeed, there exist many specific discrepancies between that species and the Japanese form which have been considered identical by authors. The principal differences consist in the structure of the funnel organ, hectocotylus, and spermatophores. Of these points I shall have to speak more in detail in another publication.

22. POLYPUS MACROPUS, var. MINOR, new variety.

Station 5074 (Suruga Bay). Two mature males. Cat. No. 332963, U.S.N.M.

Surface faintly warty, rather soft to the touch. Body elongated, nearly fusiform, somewhat pointed behind; no horizontal ridge present on sides nor longitudinal groove on belly. Mantle opening broad, extending more than half around the body.

Head about as broad as body, concave above, marked off by a strong constriction both in front and behind. Funnel small, its freely projecting part slender. Funnel organ small, consisting of two far separated V-shaped pads, of which the inner limb is $\frac{1}{2}$–$\frac{2}{3}$ as long as the outer.

Arms greatly unequal, the formula of length being $1>2>3>4$; longest pair about seven times as long as body. All quadrangular in section in the proximal parts and roundish in the distal, lacking contractile web on either side. Umbrella ill developed, its radius varying with the length of the arm along which it extends. Suckers prominent, rather sparsely set in two alternating rows.

Right third arm markedly affected by hectocotylization, being much shorter than the left third; on the normal part there are found only 21 or 24 pairs of suckers. Terminal organ conspicuous, about one-seventh the entire length of the arm, nicely spoon-shaped, with ample copulatory groove.

Gill composed of only 15–17 leaflets.

Penis comparatively large, a little coiled, the entire contour being triangular, the center of which is connected with the duct of Needham's sac. Spermatophores 23 mm. long, 1 mm. thick; discharging tube 15 mm. long, smooth, neither coiling nor striated. Coils of sperm cord 19.

Principal measurements of type: Total length 182 mm.; ventral length of mantle 20 mm.; longest arm 145 mm.; left third arm 76 mm.; right third arm 3 mm.; diameter of largest sucker 2.4 mm.; longest radius of umbrella 14 mm.

Type.—Cat. No. 332963*a*, U.S.N.M.

23. POLYPUS TENUIPULVINUS, new species.

Plate 24, fig. 5.

Station 5092 (Sagami Sea). One female. Cat. No. 332977, U.S.N.M.

Consistency firm, fleshy. Skin wrinkled in all parts, dorsal surface finely tessellated with innumerable grooves, and beset with some numbers of tubercles regularly distributed almost as in *P. vulgaris*. Body compact, as long as broad, devoid of a horizontal ridge around the periphery. Head a little narrower than the body, marked off by constrictions both in front and behind. Umbrella poorly and equally developed all round.

Funnel organ peculiarly characterized, consisting of two slender hooked-shaped pads, which begin at the funnel extremity and extend two-thirds down the distance to the anus.

Arms unequal, the formula of length $1>2>3>4$ in the right side and $2>3=1>4$ in the left; the longest about twice the shortest and about one-seventh the body length; all roundish, devoid of even a trace of contractile web on either side. Suckers small, rather sparsely set in two rows but at the base of the arms they are in a zigzag line. None of the suckers specially enlarged.

Caecum of stomach elongated bent into an L-shape. Gill composed of 16 leaflets only. Vaginae thick, straight, terminating far behind the anus.

Total length 155 mm.; ventral length of mantle 19 mm.

Type.—Cat. No. 332977, U.S.N.M.

24. POLYPUS SALEBROSUS, new species.

Station 5050 (off Kinka-san). One female. Cat. No. 332969, U.S.N.M.

Station 5029 (Okhotsk Sea). One juv. female. Cat. No. 332970, U.S.N.M.

Skin rather loose, soft. Surface quite rough in all parts, thickly beset with peculiar, coarse well-defined warts, which on the lateral and ventral surface of body run together into longitudinal lines.

Body subglobose, bearing no horizontal keel around the periphery. Mantle opening of moderate breadth. Head broad, but narrower than the body. Neck constriction weak. Umbrella thick, fleshy, extending about one-third the length of the arms, but between the ventral arms its extent is only $\frac{1}{4}$–$\frac{1}{5}$. Funnel organ W-shaped, about half as long as the distance from anus to funnel extremity, situated slightly nearer to the former than to the latter.

Arms subequal, the formula of length being $4>3>2>1$; very short, even the longest only about two times or two and a half times the body-length. All conical, rather rapidly tapering toward the extremities, without contractile webs. Suckers rather sparsely set in two alternating rows; none specially enlarged.

Ovary much more expanded sideways than lengthwise. Vaginae thick, slightly curved, terminating far behind the anus. Gill composed of 19 leaflets.

Color in alcohol uniformly light cardinal to claret red throughout.

Total length of type 153 mm.; ventral length of mantle 40 mm.

Type locality.—Off Kinka-san, Rikuzen Prov.

Type.—Cat. No. 332969, U.S.N.M.

25. POLYPUS VALIDUS, new species.

Plate 24, fig. 3.

Station 4915 (near Koshiki Island, Satsuma Province). One fully mature male. Cat. No. 332971, U.S.N.M.

Consistency rather firm, fleshy. Skin thickly warty except at the ventral surface of the head, mid-ventral region of body, the margin of the umbrella, the distal parts of the three dorsal pairs of arms and the whole surface of ventral arms; all of which are quite smooth. Warts conspicuous, nearly stelliform or rosette shaped, well defined so that the skin between them is quite smooth and even. They are largest above the head and body, becoming smaller peripherally and ventrad, thus attaining a minimum size along the boundary region of the warted area; the transition from the warty to the smooth condition taking place somewhat suddenly.

Body slightly broader than long, without keel along periphery but with a deep median longitudinal sulcus on the belly. Mantle opening of moderate breadth.

Head a little narrower than the body. Neck constriction very weak. Umbrella of moderate and uniform breadth all around, extending about a quarter up the arms, continuing along either side to the extremity as a ridge.

Arms subequal, the formula of length being: $1>2>3>4$; the longest a little longer than twice the body-length. Suckers biserial excepting the first four or five, which are in a zigzag line. They become somewhat rapidly larger to the tenth pair on each arm; from

this to the fourteenth pair are the largest, which are situated near the umbrella edge; then they diminish gradually toward the extremity.

Right third arm prominently hectocotylized, robust, much shorter and thicker than the left third, terminating quite abruptly. Terminal organ short, thick, a little flattened dorso-ventrally, narrowing somewhat distad to a quite blunt extremity. Copulatory groove smooth, widely excavated. Suckers on the normal part 22 pairs.

Branchial leaflets only 15 in each gill. Penis cylindrical, 20 mm. by 4 mm. Spermatophores 48 mm. long, 1.4 mm. thick at aboral part.

Total length 184 mm.; ventral length of mantle 39 mm.

Type.—Cat. No. 332971, U.S.N.M.

Genus SCAEURGUS Troschel.

26. SCAEURGUS PATAGIATUS Berry.

Scaeurgus patagiatus Berry, Proc. Acad. Nat. Sci. Philadelphia, 1913, p. 564.—Berry, Hawaiian Cephalopoda, 1914, p. 305, pl. 47, figs. 2, 3; pl. 48, fig. 1; text fig. 19.

Station 4924 (south of Kyushu). One male. Cat. No. 332954, U.S.N.M.

The specimen differs from Berry's description in having neither the ridge-like fold above the body nor the vertical papilla behind it. Furthermore there is only one cirrus above each eye instead of two as described by Berry; the umbrella is broadest at the lateral parts not at the dorsal.

Suborder DECAPODA Leach

Division MYOPSIDA d'Orbginy.

Family LOLIGINIDAE d'Orbigny.

Genus LOLIGO Schneider.

27. LOLIGO EDULIS Hoyle.

Loligo edulis Hoyle, *Challenger* Cephalopoda, 1886, p. 152, pl. 23.

Station 4963 (Kii-suido). Two young. Cat. No. 332902, U.S.N.M.

28. LOLIGO JAPONICA Steenstrup.

Loligo japonica Hoyle, *Challenger* Cephalopoda, 1886, p. 157, pl. 24, figs. 7–15.

Station Hakodate. Two females. Cat. No. 332904, U.S.N.M.

Hakodate market. One female and seven males. Cat. No. 332903, U.S.N.M.

29. LOLIGO BLEEKERI Keferstein.

Loligo bleekeri Keferstein, Bronn's Klass. und Ordn. d. Thierreiches, 1866, p. 1402, pl. 122, figs. 9, 10; pl. 127, fig. 14.—Appellöf, Japanska Cephalopoder, 1886, p. 31. pl. 1, figs. 7–10.

Station 4872 (east of Tsushima). Thirty-one young. Cat. No. 332905, U.S.N.M.

Station 4873 (east of Tsushima). Three young. Cat. No. 332906, U.S.N.M.

Genus SEPIOTEUTHIS de Blainville.

30. SEPIOTEUTHIS LESSONIANA Férussac.

Sepioteuthis lessoniana FÉRUSSAC and D'ORBIGNY, Céphalopodes acétabulifères 1839, p. 302, Sepioteuthis, pl. 1; pl. 6, figs. 9–14.—APPELLÖF, Japanska Cephalopoder, 1886, p. 32, pl. 1, fig. 11; pl. 3, figs. 11–15.

Kagoshima market. One specimen. Cat. No. 332944, U.S.N.M.

Family SEPIOLIDAE Keferstein.

Subfamily SEPIOLINAE Hoyle.

Genus SEPIOLA Leach, emendation.

31. SEPIOLA BIROSTRATA Sasaki.

Sepiola inioteuthis SASAKI, Zool. Mag. Tokyo, vol. 25, 1913, p. 251, 1 fig. (part.)
Inioteuthis inioteuthis SASAKI, Ann. Zool. Japon., vol. 8, 1914, p. 594 (part).
Sepiola birostrata SASAKI Zool. Mag. Tokyo, vol. 30, 1918, p. 235.

Station 4807 (Tsugaru Strait). One female. Cat. No. 332878. U.S.N.M.

Station 4835 (Wakasa Bay). Two males and females. Cat. No. 332879, U.S.N.M.

Station 4835 (Wakasa Bay). One female and two males. Cat. No. 332880, U.S.N.M.

Station 4838 (Wakasa Bay). One female and five males. Cat. No. 331881, U.S.N.M.

Station 4839 (Wakasa Bay). One male and female. Cat. No. 332882, U.S.N.M.

Station 4843 (near Oki Island). One female, two males and one juv. Cat. No. 332883, U.S.N.M.

Station 4844 (Wakasa Bay). Six males. Cat. No. 332884, U.S. N.M.

Station 4868 (east coast of Korea). One male. Cat. No. 332885, U.S.N.M.

Station 5031 (Nemuro Strait). One male. Cat. No. 332886, U.S. N.M.

Station 5032 (Nemuro Strait). One female. Cat. No. 332887, U. S.N.M.

Station 5046 (off Kinka-san). One male. Cat. No. 332888, U.S N.M.

Station 5047 (off Kinka-san). One female and two males. Cat. No. 332989, U.S.N.M.

Station —5048 (off Kinka-san) One male and one female. Cat. No 332890, U.S.N.M,

Station 5050 (off Kinka-san). One female. Cat. No. 332891, U.S. N.M.

Station Sado Island. One female. Cat. No. 332877, U.S.N.M.

This species has not been fully described in English so that a description of it here seems to be advisable.

Mantle purse-shaped, a little longer than broad; anterior margin connected with the head at the nape by a commissural integument narrower than one-third the body-breadth; ventral edge emarginated crescentwise, the excavation marked off by projections. Fins semilunar or subovate, about five-sevenths as broad as long, and $\frac{1}{2}$–$\frac{3}{4}$ as long as the body; auriculated anteriorly, attached to the dorso-lateral surfaces of the body at the middle of its length.

Head as wide as, or even broader than body; with large full eyes which form an incompletely circular lid-fold ventrally. Umbrella ill developed except between third and fourth arms, where it extends about a quarter up the arms. Funnel slender, extending less than to interbrachial space, clearly marked off throughout, widely conical at base and tubular distally. Funnel organ composed of a triangular dorsal pad and two elliptical ventral pads. Funnel cartilage oblong, a little longer than three times its own breadth.

Arms subequal, the formula of length being $2=3>4=1$, the longest about as long as the body. Third pair in mature males peculiarly thickened in the proximal parts, attenuated in the distal, and strongly curved into the shape of an S. Suckers biserial, numbering about 25 pairs on each arm; in the female, small and comparatively uniform; in male, unequal, largest at the middle of arms but uniform in first arms and rudimentary in the third.

Left dorsal arm prominently hectocotylized, $\frac{1}{2}$–$\frac{4}{5}$ as long as the right dorsal; thickened, terminating abruptly. On the base of the arm, there are found four or five minute suckers, followed by a large rounded swelling on the ventral side; the swelling produces two conical sharply pointed recurved rostra, of which the anterior one is usually much larger than the posterior. The remaining part of the arm has about 40 papillae tightly palisaded in two rows and bearing minute suckers on their tips.

Tentacles slender, decidedly thinner than any of the arms, and twice as long as the ventral arms. Club about one-fourth the entire length of tentacles, slightly expanded, flattened, with very narrow dorsal web. A broad semilunar membrane is present on the dorsal side of the carpus. Suckers equally minute, shallow, numbering only four in a row at the base of the club but about sixteen in a row at its subterminal part; horny ring with about twenty blunt separate teeth.

Saddle-shaped luminous organ well developed. Spermatophores about 13 mm. long.

Mantle length 8–15 mm. in males, 8–14 mm. in females.

Genus EUPRYMNA Steenstrup.

32. EUPRYMNA MORSEI (Verrill).

Inioteuthis morsei VERRILL, Trans. Conn. Acad. Sci., vol. 5, 1881, p. 417, footnote.—APPELLÖF, Japanska Cephalopoder, 1888, p. 15, pl. 2, fig. 15; figs. 16, pl. 3, figs. 16, 19, 20, 23.—HOYLE, *Challenger* Cephalopoda, 1886, p. 112, pl. 14, figs. 1-9.

Euprymna morsei STEENSTRUP, Notae Teuthologicae, vol. 7, 1887, pp. 66, 89.—WÜLKER, Doflein Beitr. Naturgesch. Ostasiens, 1910, p. 9, pl. F, fig. 9; pl. 3, figs. 23, 24; pl. 4, fig. 40.—BERRY, Japanese Cephalopoda, 1912, p. 408, pl. 6, figs. 1, 2.

Station Shimizu, Suruga. One male. Cat. No. 332876, U.S.N.M.

33. EUPRYMNA SIMILIS Sasaki.

Euprymna similis SASAKI, Ann. Zool. Japon, vol. 8, 1914, p. 591, pl. 11, figs. 5–8.

Station Hakodate market. Two males and three females. Cat. No. 332872, U.S.N.M.

Station Hakodate Bay. Five females and ten males. Cat. No. 332873, U.S.N.M., Cat. No. 332874, U.S.N.M. and Cat. No. 332875, U.S.N.M.

These specimens agree in some points with Berry's description of *E. scolopes*, but the proximal suckers of the hectocotylized arm are much fewer than given by him, numbering only 23–27, and the nipple-like protuberances (Berry's modified papillae) of the arm are less modified, often revealing the appearance of ordinary suckers. In the males from Hakodate Bay, the three ventral arms resemble those of the male described by Berry in having about ten conspicuous suckers in the ventral marginal row; this seems, however, to be a case of abnormality.

Genus SEPIOLINA Naef.

34. SEPIOLINA NIPPONENSIS (Berry).

Stoloteuthis nipponensis BERRY, Zool. Anz., vol. 37, 1911, p. 39, 1 fig., Japanese Cephalopoda, 1912, p. 414, pl. 5, figs. 1–4.

Sepiolina nipponensis NAEF, Teutholog. Notizen, vol. 1, 1912, p. 248.—SASAKI, Ann. Zool. Japon, vol. 8, 1914, p. 597.

Station 4903 (near Goto Islands). One male. Cat. No. 332865, U.S.N.M.

Station 4940 (Van Diemen Strait). One male. Cat. No. 332866, U.S.N.M.

Station 4941 (Van Diemen Strait). Two females and four males. Cat. No. 332867, U.S.N.M.

Station 4942 (Van Diemen Strait). One male. Cat. No. 332868, U.S.N.M.

Station 4943 (Van Diemen Strait). Two females and three males. Cat. No. 332869, U.S.N.M.

Station 5055 (Suruga Bay). One male. Cat. No. 332870, U.S.N.M.

Station 5069 (Suruga Bay). One female. Cat. No. 332871, U.S.N.M.

These specimens differ from Berry's description at least in having broader umbrella and smaller fins. The latter do not extend to the anterior margin of the mantle, the forward lobe being somewhat shorter than illustrated by him. In good specimens the periphery of the belly is embellished by a broad distinct U-shaped zone of pearly luster.

Genus ROSSIA Owen.

35. ROSSIA PACIFICA Berry

Rossia pacifica BERRY, Bull. Bureau Fish., vol. 30, 1912, p. 290, pls. 41–42; pl. 43, figs. 1–4; pl. 44, figs. 1, 5.—SASAKI, Ann. Zool. Japon, vol. 8, 1914, p. 598.

Station 4779 (near Semipochnoi Island, Aleutians). Two females. Cat. No. 332825, U.S.N.M.

Station 4784 (near Attu Island, Aleutians). Two males. Cat. No. 332817, U.S.N.M.

Station 4810 (Tsugaru Strait). One female. Cat. No. 332819, U.S.N.M.

Station 4812 (north of Sado Island). Two males and three females. Cat. No. 332809, U.S.N.M.

Station 4813 (north of Sado Island). One male and seven females. Cat. No. 332803, U.S.N.M.

Station 4822 (Noto Peninsula). Three females and five males. Cat. No. 332807, U.S.N.M.

Station 4826 (Noto Peninsula). One female. Cat. No. 332822, U.S.N.M.

Station 4828 (Noto Peninsula). One male. Cat. No. 332815, U.S.N.M.

Station 4834 (off Echizen Province). One male and female. Cat. No. 332821, U.S.N.M.

Station 4835 (off Echizen Province). One female. Cat. No. 332829, U.S.N.M.

Station 4838 (Wakasa Bay). One female. Cat. No. 332826, U.S.N.M.

Station 4843 (near Oki Island, Krusenstern Strait). One male and female. Cat. No. 332827, U.S.N.M.

Station 4844 (near Oki Island, Krusenstern Strait). One male and female. Cat. No. 332810, U.S.N.M.

Station 4844 (near Cape Clonard, Korea). One male. Cat. No. 332816, U.S.N.M.

Station 4858 (near Cape Clonard, Korea). Three females and four males. Cat. No. 332828, U.S.N.M.

Station 4859 (near Cape Clonard, Korea). Two females. Cat. No. 332811, U.S.N.M.

Station 4860 (near Cape Clonard, Korea). Two males. Cat. No. 332808, U.S.N.M.

Station 4868 (near Cape Clonard, Korea). Two females and four males. Cat. No. 332812, U.S.N.M.

Station 4869 (near Cape Clonard, Korea). One female and two males. Cat. No. 332820, U.S.N.M.

Station 4870 (near Cape Clonard, Korea). One male and female. Cat. No. 332812, U.S.N.M.

Station 4871 (near Cape Clonard, Korea). One female. Cat. No. 332802, U.S.N.M.

Station 4989 (near Kamoi-saki, Hokkaido). Two males and three females. Cat. No. 332801, U.S.N.M.

Station 4993 (near Rebun Island, Hokkaido). Five males. Cat. No. 332813, U.S.N.M.

Station 4994 (near Rebun Island, Hokkaido). Two males. Cat. No. 332818, U.S.N.M.

Station 5010 (near Korsakova, Sakhalin). One female and two males. Cat. No. 332814, U.S.N.M.

Station 5031 (Nemuro Strait). One male and two females. Cat. No. 332823, U.S.N.M.

Station 5042 (off Hidaka Province, Hokkaido). Four females and six males. Cat. No. 332805, U.S.N.M.

Station 5047 (off Kinka-san). Two females and three males. Cat. No. 332824, U.S.N.M.

Station 5048 (off Kinka-san). Four males and females. Cat. No. 332804, U.S.N.M.

These specimens measure from 12 mm. to 79 mm. in length, and are all properly referred to the present species. A female from station 5031 differs from the others in having a very slender body, though revealing no differences in other respects. The measurements of this specimen are as follows: Dorsal length of mantle 65 mm.; breadth of mantle 34 mm.; length of fins 34 mm.; breadths of fins 20 mm. and 18 mm.

36. ROSSIA MOLLICELLA, new species.

Plate 25, fig. 1.

Station 4967 (off Kii Province). Two females. Cat. No. 332831, U.S.N.M.

Station 4972 (off Kii Province). One male. Cat. No. 332833, U.S.N.M.

Station 5051 (off Kinka-san). One female. Cat. No. 332832, U.S.N.M.

Surface smooth, very soft to the touch, the integument being rather flabby.

Mantle expanded anteriorly, rounded posteriorly, as long as wide or a little longer. Anterior margin free all round, its ventral part projecting forward more than the dorsal margin but with a faint

emargination in the middle. Fins very large, nearly semilunar, about four-fifths as broad as long, and about two-thirds as long as the mantle-length, feebly indented at the anterior origin.

Head very large, decidedly broader than mantle, with big eyeballs. Nuchal cartilage oblong, a little shorter than twice its breadth, nearly parallel-sided and similarly rounded on both ends. Funnel broad. Funnel organ as in *R. pacifica*. Funnel cartilage oblong, a little longer than twice its own breadth.

Arms unequal, the formula of length being $3=2>1>4$; the longest a little longer than the mantle-length. Suckers biserial, on the whole, a little larger in the male than in the female, specially so on the lateral arms. Horny ring smooth; external aperture narrow and slit-like; papillate area narrow, composed of about seven rows of facets, the papillae of which are all faint. Umbrella similarly narrow all around.

Both dorsal arms hectocotylized, being quite similarly constructed in every respect. On the lateral aspect of the outer side there is found a deep groove, marked off by a wide fold running through the entire length. The suckers of these arms are affected but little by hectocotylization, and number 42 and are only a little smaller than those of the lateral arms.

Tentacles when bent back, reaching the posterior end of the mantle. Stem about as thick as, or a little thinner than, the arms. Club occupying a quarter of the tentacle, not expanded, bent round, with a narrow semilunar membrane on the dorsal side of the carpus. Suckers numerous, minute, nearly uniform, arranged in about eight rows; horny ring smooth.

Measurements of type: Dorsal length of mantle 36 mm.; ventral length of mantle 39 mm.; breadth of mantle 33 mm.; length of longest arm 42 mm.; diameter of largest arm-sucker 19 mm.

This species stands near *R. megaptera* but differs from it in the ventral margin of the mantle, in the tentacular length, in the arm-formula, and in the horny ring of arm-suckers.

Type-locality.—Off Kii Province.

Type.—Cat. No. 332833, U.S.N.M.

37. ROSSIA BIPAPILLATA, new species.

Plate 25, fig. 3.

Station 5069 (Suruga Bay). One female. Cat. No. 332830, U.S.N.M.

Surface smooth, soft to the touch. Mantle a little longer than broad, of nearly equal breadth in the anterior half, rounded posteriorly. Mantle margin free all around; its ventral part projecting as much as the mid-dorsal part, and forming a shallow crescentic emargination in the middle. Fins large, being only a little shorter than the body; semicircular, about half as long again as broad, their anterior origin somewhat indented, and the most anterior edge extending a little beyond the mantle margin.

Head wider than the mantle, with full, large eyeballs. Umbrella very narrow, funnel organ composed of a conspicuous horseshoe-shaped dorsal pad and two ovate ventral pads. Funnel cartilage oblong, slightly longer than twice its own breadth.

Arms long, subequal, the formula being $3>2>1=4$; the longest as long as the mantle. Suckers biserial, nearly uniform; aperture circular. Horny ring smooth; papillate area composed of an irregularly radiated narrow margin and about four irregular rows of plates; these have a minute indistinct papilla in the middle.

Tentacles about three times as long as the mantle-length; their stems a little thinner than the arms. Club cylindrical, slightly expanded; carpus with a narrow web on the dorsal side. Suckers exceedingly numerous, very minute, forming oblique rows of 24 each.

A peculiar papilliform organ of unknown function developed on either side of the rectum.

Length of mantle 19 mm.; maximum breadth of mantle 16 mm.; length of longest arm 20 mm.; diameter of largest sucker 0.8 mm.

Type.—Cat. No. 332830 U.S.N.M.

Family IDIOSEPIIDAE Appellöf.

Genus IDIOSEPIUS Steenstrup.

38. IDIOSEPIUS PYGMAEUS Steenstrup.

Idiosepius pygmaeus, Steenstrup, Danske Vid. Selsk. Skrift., ser. 6, vol. 1, 1881, p. 219, pl. 1, figs. 11–22.—Appellöf, Cephalopoden von Ternate, 1898, pp. 562, 572, pl. 32, figs. 1–5, 7; pl. 33, figs. 11–13, 20, 22; pl. 34, figs. 24, 26, 29, 30.—Sasaki, Ann. Zool. Japon., vol. 8, 1914, p. 599.

Station Hakodate Bay. One male and female specimen. Cat. No. 332893, U.S.N.M., and Cat. No. 332894, U.S.N.M.

These specimens agree with Appellöf's description more than with Steenstrup's. The hectocotylized arms have each seven suckers, and the tentacles are as thick as the arms, their distal two-thirds beset with about 42–50 suckers of bi-quadriserial arrangement. Mantle-length 12 mm. in male and 15 mm. in female.

Family SEPIIDAE.

Genus SEPIA Linnaeus.

39. SEPIA ESCULENTA Hoyle.

Sepia esculenta Hoyle, *Challenger* Cephalopoda, 1886, p. 129, pl. 18, figs. 1–6.—Appellöf, Japanska Cephalopoder, 1886, p. 28, pl. 3, figs. 1–6.—Sasaki. Annot. Zool. Japon. vol. 8, 1914, p. 611.

Station: Tsuruga, Tango Prov. One male. Cat. No. 332834, U.S.N.M.

This specimen is a fully mature male, measuring 153 mm. in mantle length. It agrees well with Hoyle's description and the mid-ventral

groove of the gladius is shallower than was illustrated by Appellöf. The modified suckers in the hectocotylized arm number about 20.

40. SEPIA ELLIPTICA Hoyle.

Sepia elliptica HOYLE, *Challenger* Cephalopoda, 1886, p. 131, pl. 19, figs. 14–24.—WÜLKER, Doflein Beitr. Naturgesch. Ostasiens, 1910, p. 11.—BERRY, Japanese Cephalopoda, 1912, p. 419.—SASAKI, Ann. Zool. Japon., vol. 8, 1914, p. 612, pl. 11, figs. 11, 12.

Station 4938 (near Sata-misaki, Kiushiu.) One female. Cat. No. 332844, U.S.N.M.

Station 4876 (Krusenstern Str.). Two specimens. Cat. No. 332847, U.S.N.M.

The mantle of these specimens measures 26–31 mm. in length. They agree well with Hoyle's description except that the rim of the inner cone runs straight posteriad, bordering the striated area throughout and does not curve nor rise into any special wall-like ridge.

41. SEPIA CARINATA, new species.

Plate 25, fig. 2; plate 26, fig. 1.

Station 5092 (Sagami Sea). One specimen. Cat. No. 332849, U.S.N.M.

Station 5094 (Sagami Sea). One specimen. Cat. No. 332848, U.S.N M.

Mantle roughly ovate in contour, a little narrower than half its own dorsal length, pointed behind; dorsal margin protruding far over the head in a triangular lobe about one-fifth the entire length. Fins rather wide, about one-fifth as wide as the mantle, beginning at some distance from the mantle margin and extending so far backward that their bases come almost into contact with each other above the rostum. Head a little wider than the mantle and one-third as long.

Arms subequal, the lateral pairs shorter than the others, which are about one-third as long as the mantle. Suckers thickly set in four series, except at the extreme base and tip of arms where they are biserial. Horny ring smooth, but sometimes armed with very short, broad, unequal teeth on the margin.

Tentacles about as long as the mantle. Club somewhat flattened, expanded, curved into a crescent-shape, occupying the distal sixth of the tentacle. Suckers seemingly in five series, but numbering eight in an oblique-transverse row; unequal, about three in a submedian series being by far the largest, and larger than the arm-suckers. Horny ring of these largest suckers armed with about 20 blunt or square-cut, far separated teeth.

Gladius very broad, thin, two and a half times as long as its own maximum breadth, which is, in turn, three or four times as broad as the thickness. Dorsal surface evenly convex, but its antero-mesial

part flattened except for a faint broad longitudinal ridge marked off by two shallow grooves on the sides; the post-mesial part characteristically elevated into a short but broad ridge. Calcareous deposition very thin but considerably extensive so that the naked area is almost obliterated. Ventral surface shallowly concave in the posterior parts but convex in the anterior, the convexity equaling that of the dorsal surface in depth; median groove very narrow and shallow especially in the last loculus. The outer cone starts in the vicinity of the anterior end of striated area, forming a part of the margin on both sides of the same area, and abruptly expanded in the posterior parts into a broad cup-shaped cone. Inner cone poorly developed, its rim very thin throughout, without forming any actual cone but a thickened arch overhanging the shallow posterior hollow of the shell. Locular index 42–44.

Measurements of type: dorsal length of mantle 26 mm.; breadth of same 14 mm; mantle extent before fins 3 mm.; longest arm 9 mm.

Type.—Cat. No. 332849, U.S.N.M.

42. SEPIA APPELLÖFI Wülker.

Sepia appellöfi WÜLKER, Doflein Beitr. Naturgesch. Ostasiens, 1910, p. 14, figs. 8, 15–18.

Sepia (Doratosepion) applellöfi BERRY, Japanese Cephalopoda, 1912, p. 424.—SASAKI, Annot. Zool. Japon., vol. 8, 1914, p. 618.

Station 4875 (Krusenstern Strait). One male and female.

Station 4884 (west of Amakusa, Kiushiu). One female.

Station 4885 (west of Amakusa, Kiushiu). Two specimens. Cat. No. 332839, U.S.N.M.

Station 4933 (off Satamisaki, Kiushiu). One juv. Cat. No. 332843, U.S.N.M.

Station 5095 (Sagami Sea). One female. Cat. No. 332842, U.S.N.M.

These specimens agree well with Wülker's description, but the specimen from the station 4933, which is a young individual of 32 mm. mantle length, has a much wider gladius than the original specimen. This seems, however, due to age and not to difference in species.

43. SEPIA ANDREANA Steenstrup.

Sepia andreana STEENSTRUP, Danske Vid. Selsk. Skrift, ser. 5, vol. 10, 1875, p. 474, pl. 1, figs. 11–19.—WÜLKER, Doflein Beitr. Naturgesch. Ostasiens, 1910, pp. 19, 22, 24.

Sepia (Doratosepion) andreana BERRY, Japanese Cephalopoda, 1912, p. 422.—SASAKI, Annot. Zool. Japon., vol. 8, 1914, p. 613.

Hakodate market. One male and four females. Cat. No. 332835, U.S.N.M., and Cat. No. 332836, U.S.N.M.

Hakodate. Six specimens. Cat. No. 332837, U.S.N.M.

In the female of the above list, the arm-formula is not constant, being $2>3=1=4$, or $2>1=3>4$, or $2>3>1>4$. The second arms are only slightly longer than the others and not so peculiarly elongated nor otherwise characterized as in the males; this causes the specimen to closely resemble *Sepia kobiensis* in appearance.

44. SEPIA PETERSENI Appellöf.

Sepia peterseni APPELLÖF, Japanska Cephalopoder, 1886, p. 23, pl. 2, figs. 1–6. pl. 3, fig. 21.—WÜLKER, Doflein Beitr. Naturgesch. Ostasiens, 1910, p. 14.

Sepia (*Doratosepion*) *peterseni* BERRY, Japanese Cephalopoda, 1912, p. 423.—SASAKI, Annot. Zool. Japon., vol. 8, 1914, p. 618.

Station 4961 (Kii-suido). Two males. Cat. No. 332845, U.S.N.M.

Station 4963 (Kii-suido). Two males. Cat. No. 332846, U.S.N.M.

The specimens from the station 4963 are both young, measuring 30 mm. and 41 mm. in mantle length, respectively. They differ from the adult in having a broader mantle and head, and much shorter arms, which measure only half the length of mantle or even shorter.

45. SEPIA MISAKIENSIS Wülker.

Sepia misakiensis WÜLKER, Doflein Beitr. Naturgesch. Ostasiens, 1910, p. 15, figs. 5, 6, 19, 22.

Sepia (*Doratosepion*) *misakiensis* BERRY, Japanese Cephalopoda, 1912, p. 424.—SASAKI, Annot. Zool. Japon., vol 8, 1914, p. 617.

Station 4930 (south of Kiushiu). One male. Cat. No. 332838, U.S.N.M.

The specimen has a mantle length of 58 mm., and agrees well with Wülker's description.

46. SEPIA KOBIENSIS Hoyle.

Sepia kobiensis HOYLE, *Challenger* Cephalopoda, 1886, p. 142, pl. 18, figs. 7–14.—APPELLÖF, Japanska Cephalopoder, 1886, p. 20, pl. 3, fig. 7.—ORTMANN, Japansche. Cephalopoden, 1888, p. 654.

Sepia (*Doratosepion*) *kobiensis* BERRY, Japanese Cephalopoda 1912, p. 423.—SASAKI, Annot. Zool. Japon., vol. 8, 1914, p. 617.

Station 4874 (Krusenstern Strait). Six specimens. Cat. No. 332859, U.S.N.M.

Station 4876 (Krusenstern Strait). Two specimens. Cat. No. 332864, U.S.N.M.

Station 4883 (west of Amakusa, Kiushiu). One female. Cat. No. 332851, U.S.N.M.

Station 4884 (west of Amakusa, Kiushiu). Two specimens. Cat. No. 332856, U.S.N.M.

Station 4885 (west of Amakusa, Kiushiu). Two males and three females. Cat. No. 332852, U.S.N.M.

Station 4937 (near Satamisaki, Kiushiu). One specimen. Cat. No. 332854, U.S.N.M.

Station 4938 (near Satamisaki, Kiushiu). One male. Cat. No. 332855, U.S.N.M.

Station 4946 (mouth of Kagoshima Bay). Two specimens. Cat. No. 332860, U.S.N.M.

Station 5095 (Sagami Sea). Two males and females. Cat. No. 332858, U.S.N.M.

Tsuruga. One female. Cat. No. 332850, U.S.N.M.

Shimizu, Suruga Province. One female. Cat. No. 332853, U.S.N.M.

Akune, Satsuma Province. One female. Cat. No. 332857 U.S.N.M.

The specimens from station 4946 agree very well with Hoyle's original description, the only discrepancies from this being that the longest arms are not the second pairs but the fourth, and that the fins extend straight to above the spine and do not pass on to the ventral surface of the mantle. The remaining specimens accord with Appellöf's description better than that of Hoyle's, especially in the structure of the gladius.

47. SEPIA KOBIENSIS, var. ALBATROSSI, new variety.

Plate 26, figs. 2, 3.

Station 4875 (Krusenstern Strait). One mature male and two females. Cat. 332862, U.S.N.M.

Station 4878 (Krusenstern Strait). One female. Cat No. 332863, U.S.N.M.

Station 4931 (near Yakushima). One juv. female. Cat. No 332861, U.S.N.M.

This variety is separated from the typical form by the weaker hectocotylization, by the smaller size of spermatophores, by the more rounded contour of the posterior end of the gladius and by the parabolic curvature of the posterior rim of the inner cone. Measurements of type: dorsal length of mantle 34 mm.; breadth of mantle 14 mm.; maximum breadth of fins 2 mm.; length of first arms 13 mm.; of second arms 9 mm.; of third arms 8 mm.; of fourth arms 10 mm.; diameter of largest armsucker 0.4 mm.; of largest tentacular sucker 0.6 mm.; breadth of gladius 7 mm.

Type-locality.—Krusenstern Strait.

Type.—Cat. No. 332862a, U.S.N.M.

Division OEGOPSIDA d'Orbigny.

Family ENOPLOTEUTHIDAE Pfeffer.

Genus ENOPLOTEUTHIS d'Orbigny.

48. ENOPLOTEUTHIS CHUNII Ishikawa.

Enoploteuthis chunii Ishikawa, Journ. Coll. Agric. Tokyo, vol. 4, 1914, pp. 401–413. pls. 38–39.—Sasaki, Annot. Zool. Japan., vol. 9, 1916, p. 91.

Station 4957 (Bungo-suido, from stomach of fish). One male and female. Cat. No. 332945, U.S.N.M.

These specimens are largely mutilated, yet well reveal the characteristics of the species. It is of special interest to have found the species in the Bungo Strait, a locality widely separated from its home.

Genus WATASENIA Ishikawa.

49. WATASENIA SCINTILLANS (Berry).

Abraliopsis scintillans BERRY, Nautilus, vol. 25, 1911, p. 93; Japanese Cephalopoda, 1912, p. 424, pls. 7, 8, and 9, figs. 1–6.

Watasenia scintillans ISHIKAWA, Zool. Anz., vol. 43, 1913, pp. 162, 336, 6 figs.—SASAKI, Journ. Coll. Agric. Sapporo, vol. 6, 1914, p. 75, pls. 1, 2; Annot. Zool. Japon., vol. 9, 1916, p. 94.

Station 4829 (east of Noto Peninsula). Arms of a male. Cat. No. 332895, U.S.N.M.

Station 4855 (near Cape Clonard, Korea). One female. Cat. No. 332896, U.S.N.M.

Station 4856 (near Cape Clonard, Korea). Five females. Cat. No. 332897, U.S.N.M.

Station 4867 (near Cape Clonard, Korea). One female. Cat. No. 332899, U.S.N.M.

Station 4859 (near Cape Clonard, Korea). Three females. Cat No. 332898, U.S.N.M.

Station 5048 (off Kinka-san, Rikuzen). One female and two males. Cat. No. 332900, U.S.N.M

Station 5049 (off Kinka-san, Rikuzen). One female. Cat. No. 332901, U.S.N.M

These specimens are all sexually mature except one from station 5048, which is a young male of 28 mm. mantle length. The female specimens measure 48–60 mm. in mantle length, and all bear spermatophores fixed at the nape.

Subfamily ANCISTROCHIRINAE Pfeffer.

Genus THELIDIOTEUTHIS Pfeffer.

50. THELIDIOTEUTHIS ALESSANDRINI (Verany).

Loligo alessandrinii VERANY, Céphalopodes Méditerranéens, 1851, p. 99, pl. 35, figs. *f–h*.

Thelidioteuthis alessandrinii CHUN, Tiefsee-Exp. Oegopsida, 1910, p. 104, pl. 7, figs. 16, 17.—PFEFFER, Plankton-Exp. Cephalopoda, 1912, p. 178, pl. 18, figs. 1–29.

Station 4960 (Hyuga-nada). One specimen. Cat. No. 332936, U.S.N.M.

This specimen is preserved in an excellent condition, and its mantle measures 26 mm. in length. It differs from Pfeffer's description in the smooth neck, in the roughly ovate whole outline of the fins, and in having seven ribs, projections and connectives of the buccal membrane. Furthermore, it has innumerable minute photo-

phores of zonary arrangement on the ventral surface, a fact not mentioned by Pfeffer nor by other writers, but which seems to be an important character of this species.

Subfamily HISTIOTEUTHIDAE Verrill.

Genus STIGMATOTEUTHIS Pfeffer.

51. (?) STIGMATOTEUTHIS DOFLEINI Pfeffer.

Calliteuthis reversa Chun, Zool. Anz., vol 29, 1906, pp. 747,751, 752, figs. 2, 4, 5.
Calliteuthis ocellata Chun, Tiefsee-Exp. Oegopsida, 1910, pp. 152, 155, 156, 157, 158, 161, 162, 164, 165, 167, 170, textfigs, 22, 23; text-pl. 1, figs. 1, 2.
Stigmatoteuthis dofleini Pfeffer, Plankton-Exp. Cephalopoda, 1912, p. 288.

Station 5082 (Totomi Province). An imperfect specimen. Cat. No. 332939, U.S.N.M.

The above specimen consists of fragments of three arms belonging to an individual which is with doubt referred to this species. The arms are probably the first, second, and third ones of the left side. The series of the larger luminous organs is present in every arm but that of the smaller ones is not discernible in any, probably due to the great maceration of the skin. The suckers are comparatively well preserved, and their horny ring has broad roughly quadrangular teeth closely set on the distal half, these number 10 or 11 in larger suckers. The third arm shows a distinct subtriangular keel on the back near the middle. The color is claret throughout and much deeper on the sucker-bearing surface.

Family GONATIDAE Hoyle, emendation.

Genus GONATUS Gray.

52. GONATUS FABRICII (Lichtenstein).

Gonatus fabricii Steenstrup, Overs. Danske Vid. Selsk. Forth., 1881, p. 9, pl. 1.—Verrill, U.S. Fish. Comm. Report, 1882, p. 289, pl. 15, figs. 1-1*c*, 2-2*d*.—Hoyle, Proc. Zool. Soc., 1889, pp. 117-135, pls. 13, 14.—Pfeffer, Plankton-Exp. Cephalopoda, p. 230, pl. 15, figs. 17-22.

Station 4760 (South of Alaska). One juv. Cat. No. 332911, U.S.N.M.

Station 4763 (near Commandorski). One juv. Cat. No. 332912, U.S.N.M.

Station 4765 (near Near Island, Aleutians). One juv. Cat. No. 332913, U.S.N.M.

Station 4793 (east of Kamtchatcha). Four juv. Cat. No. 332917, U.S.N.M.

Station 4769 (Bering Sea). One juv. Cat. No. 332914, U.S.N.M.

Station 4772 (Bering Sea). One male Cat. No. 332915, U.S.N.M.

Station 4775 (Bering Sea). Two juv. Cat. No. 332916, U.S.N.M.

Milne Bay, Simushir (from stomach of a Gull). Only arms. Cat. No. 332910, U.S.N.M.

The specimen from station 4769 is young of 40 mm. mantle-length. It differs from the similar-sized specimens hitherto described in having much longer arms and a head of more primitive structural type.

The specimens from the stations 4760, 4763, 4765, 4793, 4775, 4805, are all quite young, measuring 4–14 mm. in mantle length. Their external appearance recalls very much that of a cranchiid. Their mantle is barrel-shaped, semitransparent and somewhat membranous, showing a part of the gladius along the mid-dorsal line of mantle. The fins are minute, semicircular, attached to the extreme end of the body. The head is always deeply contracted into the mantle cavity, more or less prismatic and bears projecting eyes. The equipment of the arms consists of suckers placed in four rows; that of the tentacles is also composed of suckers, which extend nearly the whole length of the tentacles, arranged biserially at the base, quadriserially near the middle and octoserially at the extremity.

53. GONATUS MAGISTER Berry.

Gonatus fabricii (?) BERRY, Bull. Bureau Fish., vol. 30, 1912, p. 310, pl. 52, figs. 1, 2; pl. 53; pl. 54, figs. 1-4; pl. 55, figs. 1, 3-7.

Gonatus magister BERRY, Proc. Acad. Nat. Sci. Philadelphia, 1913, p. 76.—SASAKI, Annot. Zool. Japon., vol. 9, 1916, p. 97.

Station 4774 (near Bowers Bank, Beiing Sea; from Stomach of *Albatrossia pectoralis*). One young female. Cat. No. 332907, U.S.N.M.

Station 4853 (near Cape Clonard, Korea). One female. Cat. No. 332908, U.S.N.M.

Station 4983 (off Yuwanai, Hokkaido). One male. Cat. No. 332909, U.S.N.M.

These specimens agree well with Berry's description. The specimen from the station 4774 is a young of 82 mm. mantle length. It has only four hooks on the first arm, eight hooks on the second and and also on the third. The suckers of the two median rows are comparatively large, attaining twice (or more), the diameter of those of the outer rows.

GONATOPSIS, new genus.

The characters of this genus are the same as those given in the description of the type species.

Type of the Genus—Gonatopsis octopedatus.

54. GONATOPSIS OCTOPEDATUS, new species.

Plate 26, fig. 5.

Station 5029 (near Cape Patience, Sakhalin). One specimen. Cat. No. 332918, U.S.N.M.

Consistency rather soft. Body elongated, thrice as long as wide, the broadest part being one-third the length from the anterior end,

and then tapering off caudad. Fins terminal, both together of kidney-shape, deeply indented at the anterior attachment; their total breadth far greater than their length which is in turn about three and a half times the length of body.

Head a little narrower than body. Eye-opening wide, with a deep sinus a little below the middle of the anterior margin, Funnel groove ill-defined. Nuchal cartilage elongated, very slightly widening cephalad. Funnel short, deeply contracted. Funnel organ composed of one ʌ-shaped dorsal pad and two oval ventral pads. Funnel cartilage nearly lanceolate, with the sharper end anteriorly; locking groove narrow throughout, extending the whole length of the cartilage.

Arms subequal, the formula of length being $2>3>1=4$, the longest being five-sixths the length of body. All comparatively rapidly tapered in the proximal two-thirds, the remaining one-third somewhat characteristically attenuated but terminating in a comparatively blunt extremity. Armatures in the proximal two-thirds, quadriserial, consisting of two outer rows of minute suckers and two inner rows of relatively large hooks; in the distal one-third, they are composed of minute suckers arranged in 8–12 series. This is, however, exceptional for the ventral arms, where the armatures are all composed of suckers only.

Tentacles absent. Buccal membrane relatively broad, with seven marginal projections.

Total length 130 mm.; dorsal length of body 65 mm.; maximum breadth of body 22 mm.; length of first right arm 45 mm.; of second arm 55 mm.; of third arm 52 mm.; of fourth arm 53 mm.

Type.—Cat. No. 332918, U.S.N.M.

Family OMMASTREPHIDAE Gill.

Subfamily OMMASTREPHINAE Carus.

Genus OMMASTREPHES d'Orbigny.

55. OMMASTREPHES SLOANI PACIFICUS (Steenstrup).

Todarodes pacificus Steenstrup, Overs. Danske Vid. Selsk. Fotr., 1880, pp. 83, 90, etc., 1 fig.—Hoyle, *Challenger* Cephalopoda, 1886, pp. 34, 163, pl. 28, figs. 1-5.—Joubin, Bull. Soc. Zool. France. 22, 1897, p. 103.

Ommastrephes pacificus Appellöf, Japanska Cephalopoder, 1886, p. 35, pl. 3. figs. 8–10.

Ommastrephes sloani Berry, Japanese Cephalopoda, 1912, p. 433, pl. 6, fig. 4.

Ommatostrephes sloani pacificus Pfeffer, Plankton-Exp. Cephalopoda, 1912, p, 456, pl. 34, figs. 3–6.

Hakodate market. One juv. Cat. No. 332932, U.S.N.M.

Sado Island. One juv. Cat. No. 332933, U.S.N.M.

Station Ebisu market, Sado Island. Three females and one male. Cat. No. 332930, U.S.N.M.

Station 4845 (near Oki Island, Krusenstern Strait). Eight juv.

Station 4852 (east coast of Korea; from the stomach of a Raja). One female. Cat. No. 332931, U.S.N.M.

Station 4855 (near Cape Clonard, Korea). One female. Cat. No. 332929, U.S.N.M.

Station 4952 (east of Osumi). Three juv. Cat. No. 332934, U.S.N.M.

The specimens from the station 4952 are referred with hesitation to the present species. They are young specimens of 6—7.7 mm. mantle length, and have longer tentacles and more developed but smaller eyes than the other specimens of the same size.

Family CHIROTEUTHIDAE Gray.

Subfamily CHIROTEUTHINAE Chun.

Genus CHIROTEUTHIS d'Orbigny.

Subgenus CHIROTHAUMA Chun.

56. CHIROTEUTHIS (CHIROTHAUMA) IMPERATOR Chun.

Chiroteuthis (*Chirothauma*) *imperator* CHUN, Tiefsee-exped. Oegopsida, 1910, pp. 240, 241, 281, pl. 38, figs. 1–10; pl. 40, figs. 2–5, 7; pl. 41; pl. 42, figs. 1–4; pl. 43; pl. 44, figs. 3, 6–16.—PFEFFER, Plankton-exped. Cephalopoda, 1912, p. 581.

Station 4906 (near Koshiki Island, Satusma Province). One specimen. Cat. No. 332937, U.S.N.M.

Station 4951 (off Osumi Province). One specimen. Cat. No. 332938, U.S.N.M.

Genus MASTIGOTEUTHIS Verrill.

57. MASTIGOTEUTHIS CORDIFORMIS Chun.

Mastigoteuthis cordiformis CHUN, Zool. Anz., vol. 33, 1908, p. 88.—CHUN, Tiefsee-exped. Oegopsida, 1910, p. 222, pl. 34; pl. 35, figs. 1, 5, 6, 10–14; pl. 36, figs. 3–5; pl. 37, fig. 5.—PFEFFER, Plankton-exped. Cephalopoda, 1912, p. 613.

Station 5060 (Suruga Bay). One specimen. Cat. No. 332947, U.S.N.M.

This specimen is 90 mm. in mantle length, being a little larger than the type. It differs from Chun's description at least in having fainter antitragus of the funnel cartilage, more numerous teeth in arm-suckers, and shorter and less recurved teeth in tentacular suckers.

Family CRANCHIIDAE Prosch.

Genus GALITEUTHIS Joubin.

58. GALITEUTHIS ARMATA Joubin.

Galiteuthis armata JOUBIN, Ann. Sci. Nat., vol. 6, 1898, pp. 279, 292, figs. 1–9.—PFEFFER, Plankton-exped. Cephalopoda, 1912, pp. 731–736.

Station 4768 (Bering Sea). One specimen. Cat. No. 332926, U.S.N.M.

Station 4797 (Starichkof Island, Kamchatka). One specimen. Cat. No. 332927, U.S.N.M.

Of the two specimens listed above the first is an adult of 270 mm. mantle length and the second is a young of 109 mm. mantle length. The former specimen is far larger than the original and differs in many respects from Joubin's description. The head is small, being far narrower than the body and resembles at a glance that of the higher oegopsids. It is a roughly three-sided prism, one side represented by the dorsal surface, and the other two by the lateral surfaces. The dorsal surface is not evenly flat but depressed in the middle, the depression defined behind by a prominent nape. The ventral surface is represented merely by an edge of the prism although it is not sharply brought to an angle. It has a groove along its crest, marked off by stiff ridges from the lateral surfaces. The groove widens posteriorly, where it is occupied by a large bundle of the funnel adductors so that it shows no real concavity. The eyes are extensively covered with the eyelids, the eye-openings being small, and triangular. The protective membranes are largely obliterated between the trabeculae, so that these are converted into slender cirriform appendages which much recall the cirri of the Cirroteuthidae.

Genus TAONIUS Steenstrup.

59. TAONIUS PAVO (Lesueur).

Loligopsis pavo Férussac and d'Orbigny, Céphalopodes acétabulifères, 1839, p. 321, Calmars, pl. 6, figs. 1–3a, *b*; Loligopsis, pl. 6, figs. 1–3 (5, 5*bis*, 6).

Taonius pavo Joubin, *Princess Alice* Cephalopoda, 1900, p. 106, pls. 8, 9, pl. 10, figs. 7–9; pl. 15, fig. 16.—Pfeffer, Nordisches Plankton, 1908, p. 102, figs. 117, 118; Plankton-exped. Cephalopoda, 1912, p. 704.

Station 4906 (near Koshiki Island, Kiushiu). Two females. Cat. No. 332946, U.S.N.M.

These two specimens measure 330 mm. and 179 mm. in mantle length respectively and well agree with Joubin's description.

Genus MEGALOCRANCHIA Pfeffer.

60. MEGALOCRANCHIA MAXIMA Pfeffer.

Megalocranchia maxima Pfeffer, Abhandl. Naturwiss. Vereins, Hamburg, vol. 8 (pt. 1), 1884, p. 24, figs. 32, 32*a*; Plankton-exped. Cephalopoda, 1912, p. 712, pl. 48, figs. 1–4.

Station 4917 (west of Oshima Group, Kiushiu). One specimen. Cat. No. 332928, U.S.N.M.

This specimen is larger than the type, measuring 63 mm. in mantle length. Disagreeing with Pfeffer's description, the fins are only little auriculated in the anterior origin, and the protective membrane is obliterated between the trabeculae at the distal parts of arms.

Genus CRYSTALLOTEUTHIS Chun, emendation.

61. CRYSTALLOTEUTHIS BERINGIANA, new species.

Plate 26, fig. 4.

Station 4765 (Aleutian Islands). One specimen. Cat. No. 332920, U.S.N.M.

Station 4783 (Attu Island, Aleutian Islands). One specimen. Cat. No. 332921, U.S.N.M.

Station 4793 (Avacha Bay, Kamchatka). Two specimens. Cat. No. 332919, U.S.N.M.

Station 4806 (east of Erimo-saki, Hokkaido). One specimen. Cat. No. 332922, U.S.N.M.

Station 5030 (southern part of Okhotsk Sea). One specimen. Cat. No. 332923, U.S.N.M.

Body subfusiform, about one-third as broad as long, broadest a little before the middle, acuminated posteriorly. A single bifid crystalline tubercle is present on either side of the ventral margin of the mantle but none at its dorsal margin. Fins terminal, small; their combined outline shield-shaped; the total breadth slightly greater than the length which is in turn about one-ninth the length of mantle.

Head small, prismatic.' Eyes nearly mallet-shaped, with swollen peduncles. Eye-ball of a rounded lozenge shape in contour, the ventral extremity somewhat prominent though not rostrated, and covered over by a single large semilunar photophore. Dorsal pad of funnel organ roughly quadrilateral, two-thirds as deep as broad, bearing a long stiff process at the center; ventral pads rounded-quadrangular, about half as broad as the preceding pad.

Arms nearly conical, without carination; dorsal pair decidedly shorter than the others which are of about equal length and a little shorter than one-third the length of the body. Umbrella quite rudimentary. Suckers closely set in two rows, numbering about ten pairs on the dorsal arm and twelve or thirteen pairs on each of the remaining arms; horny ring with 5–7, narrow, blunt teeth along the distal margin.

Tentacles about twice as thick, and four or five times as long, as the arms. Club obscurely marked off from the stem, only a little expanded; aboral surface rounded, without dorsal web. Club suckers closely quadriserial, numbering about 45, subequal but the central ten or twelve somewhat larger than the others; horny ring almost as in arm-suckers. Stem suckers minute, sparsely biserial, numbering about 35.

Gladius extending the whole dorsal length of the mantle, very narrow, but a little expanded posteriorly into a slender lanceola.

Stomach with a single constriction near its caecum which is ovoidal and $\frac{1}{4}$–$\frac{1}{5}$ as long as the stomach. Pancreas massive, lying on the ventral aspect of liver. Bile-ducts connected with pancreas near their

exits from the liver and then united together, thus forming a Y-shaped hepato-pancreatic duct.

Measurements of type: length of body 27 mm.; breadth of body 9.2 mm.; length of fins 3 mm.; total breadth of fins 4 mm.; length of second arm 2.3 mm.; length of tentacles 13 mm.

Type locality.—Attu Island, Aleutian Islands.

Type.—Cat. No. 332921, U.S.N.M.

Subfamily CRANCHIINAE Pfeffer.

Genus LIOCRANCHIA Pfeffer.

62. LIOCRANCHIA VALDIVIAE Chun.

Liocranchia valdiviae CHUN, Zool. Anz., vol. 31, 1906, p. 84; Tiefsee-exped. Oegopsida, 1910, p. 337, pl. 48, figs. 3, 4; pl. 51, figs. 1–4, 8–14; pl. 60, figs. 7–11.—PFEFFER, Plankton-exped. Cephalopoda, 1912, p. 675.

Station 4970 (off Kii Province). One mature female. Cat. No. 332925, U.S.N.M.

This specimen is much larger than the type, measuring 63 mm. in mantle length. It deviates from Chun's description in having more numerous tubercles on the hyaline streaks of the mantle, and longer arms, the order of which is 3, 4, 2, 1, instead of 3, 2, 4, 1. Further, the arms and tentacles both have more suckers, and the connective suckers of the tentacles are accompanied with fixing pads not only at the carpal region, but throughout the entire series.

EXPLANATION OF PLATES.

PLATE 23.

FIG. 1. *Watasella nigra.* Dorsal view. × 3.
2. *Stauroteuthis albatrossi.* Hectocotytized arms. Natural size.
3. *Stauroteuthis albatrossi.* Dorsal cartilage. Natural size.
4. *Polypus tsugarensis.* Funnel laid open. × 2.
5. *Polypus pustulosus.* Funnel laid open. Natural size.

PLATE 24.

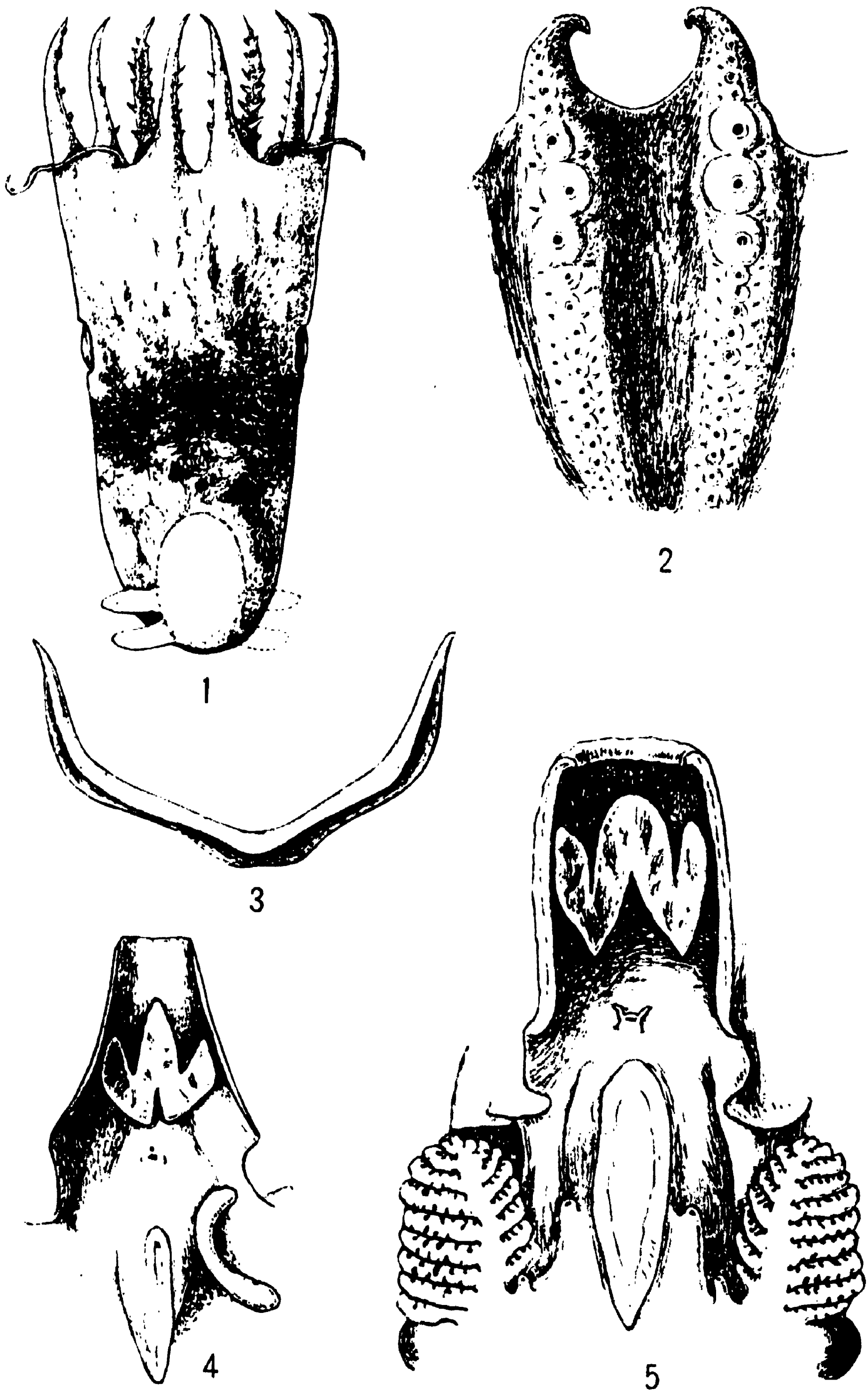
FIG. 1. *Polypus spinosus.* Funnel laid open. × 2.
2. *Polypus yendoi.* Funnel laid open. Natural size.
3. *Polypus validus.* Hectocotylus. × 2.
4. *Polypus alatus.* Male internal genital organs. *a. sp.* accessory spermatophoric gland. *N.* Needham's sac. *p.* penis. *sd.* spermiduct. *sp.* spermatophoric gland. Natural size.
5. *Polypus tenuipulvinus.* Funnel laid open. × 2.

PLATE 25.

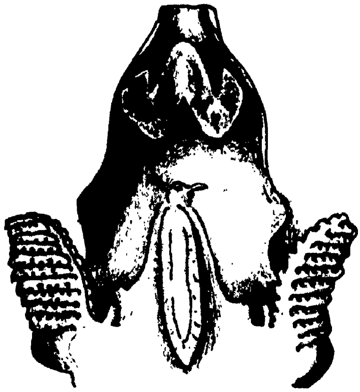
FIG. 1. *Rossia mollicella.* Arms. *h.* hectocotytized arm. × 1½.
2. *Sepia carinata.* *A.* Dorsal aspect of shell. × 3.
3. *Rossia bipapillata.* Funnel laid open. × 5.

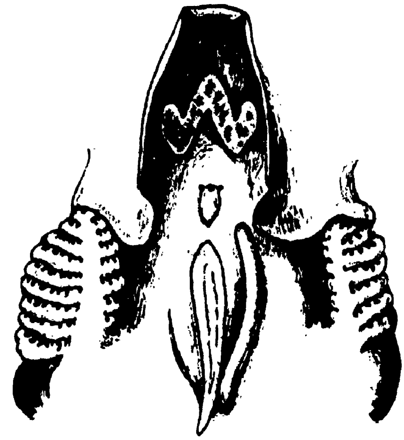
PLATE 26.

FIG. 1. *Sepia carinata.* Ventral aspect of posterior part. × 6.
2. *Sepia kobiensis*, var. *albatrossi.* Ventro-lateral view of posterior part. × 5.
3. *Sepia kobiensis*, var. *albatrossi.* Ventral aspect of shell. × 2.
4. *Crystalloteuthis beringiana.* Ventro-lateral view of head and arms. × 6.
5. *Gonatopsis octopedatus.* Ventral view. Natural size.



NEW CEPHALOPODS FROM THE NORTHWESTERN PACIFIC.





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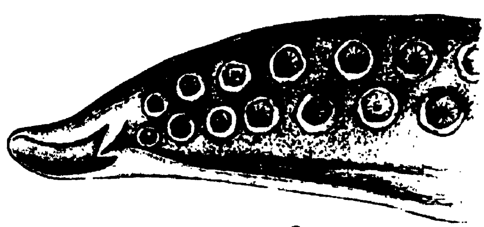

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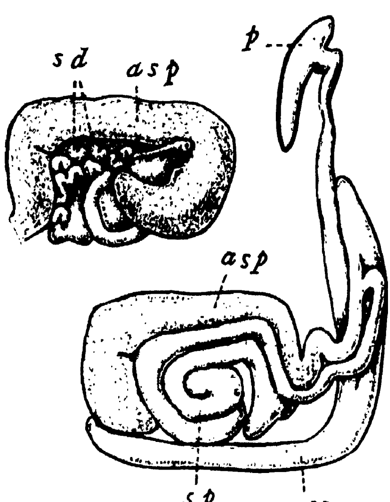

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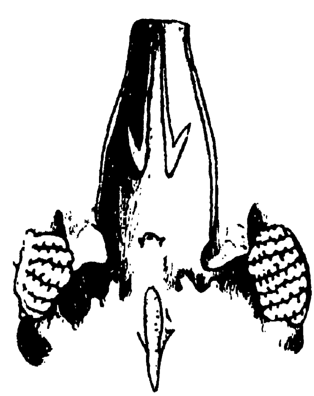

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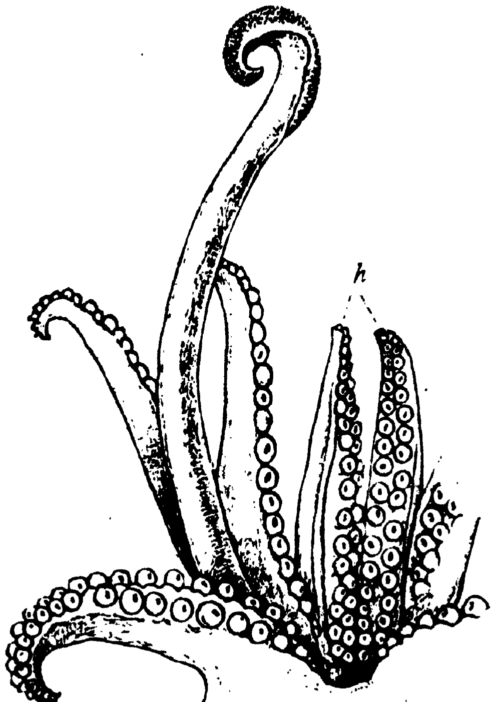

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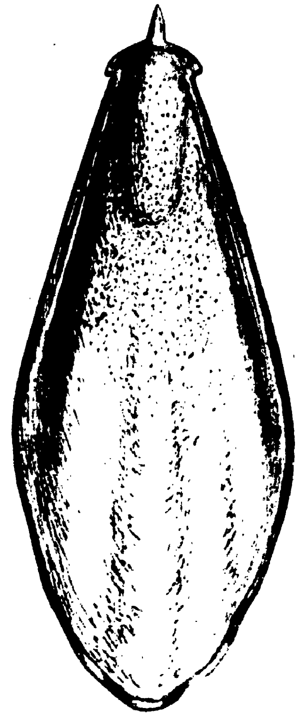
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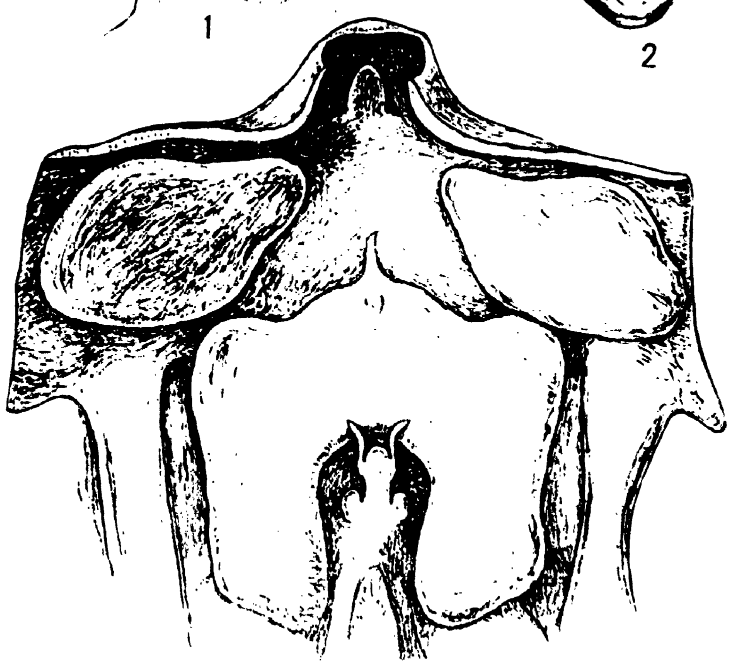
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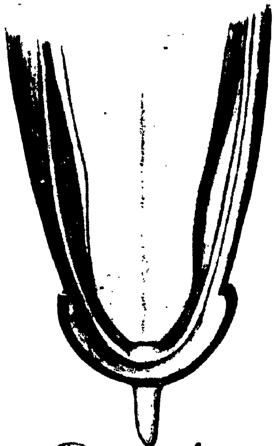

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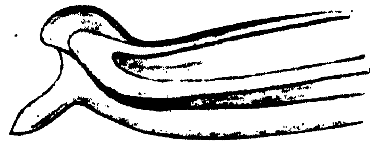

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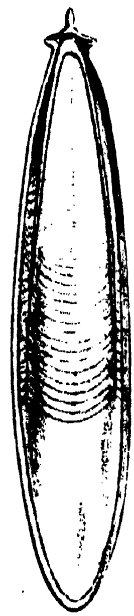

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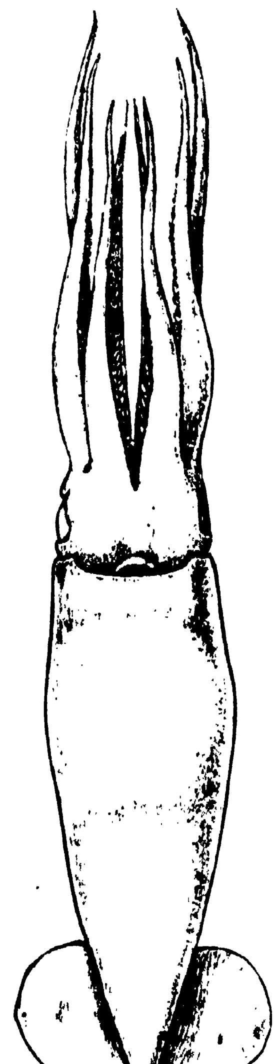

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NEW CEPHALOPODS FROM THE NORTHWESTERN PACIFIC.

AMERICAN RECORDS OF WHALES OF THE GENUS PSEUDORCA.

By Gerrit S. Miller, Jr.
Curator, Division of Mammals, United States National Museum.

Hitherto the only positive record of the occurrence of whales of the genus *Pseudorca* in American waters appears to rest on the type specimen (rostrum and jaws, No. 3679, U.S.N.M.) of Cope's *Orca destructor*,[1] taken off Paita, Peru. A skull (No. 11320, U.S.N.M.) supposed to have come from the northeast coast of North America ("very probably it was originally obtained in Davis Strait") is mentioned in True's Review of the family Delphinidæ.[2] On the evidence of this specimen the false killer has been regarded as a North American mammal. Search of the museum records has failed to reveal any history other than the entry in the catalogue made by Prof. S. F. Baird on October 15, 1870: "*Orca.* N. E. Coast. Nantucket Athenaeum." So vague a statement—"N. E." might as well mean New England as northeast—can not be regarded as establishing the cosmopolitan genus *Pseudorca* as part of the North American fauna. The whalers of Nantucket did not confine their operations to the "northeast coast"; the mere fact that this skull was regarded by one of them as of enough interest to be deposited in the Athenaeum would of itself suggest an origin more remote.

It is now possible to record three authentic occurrences of *Pseudorca* in North America; also one in the Caribbean Sea.

The South American specimen (No. 20932, U.S.N.M.) is a much-weathered skull and imperfect skeleton from one of the Aves Islands in the Caribbean Sea 70 miles off the coast of Venezuela. It was received in 1883 from Faarup and Gorsira, merchants in Willemstad, Curaçao, through Almont Barnes, U. S. Consul. Mr. Barnes writes under date of May 24, 1883: "I have to-day had boxed and will send you this week some bones of a large animal which were found on one of the Aves Islands, about 70 miles off the coast of Venezuela. There appears to be quite a bone bed there. The Aves Islands are visited at times for guano, and the bones I will send are some brought here with smaller ones for sale merely as 'old bones.'"

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[1] Proc. Acad. Nat. Sci. Philadelphia, 1866, p. 293. [2] Bull. U. S. Nat. Mus. 36, p. 144, 1889.

Of the North American specimens, one (No. 23282, U.S.N.M.), a weathered skull and imperfect skeleton, was obtained by the U. S. Fish Commission steamer *Albatross* at Pichilinque Bay, the United States coaling station near La Paz, Lower California, on April 29, 1888. The others, No. 218360, U.S.N.M., a skull and nearly complete skeleton (lacking a few vertebrae, a few ribs, and the fore limbs), and No. 218361, U.S.N.M., 13 detached teeth, were recently procured near Princeton, Florida, by Lawrence S. Chubb. In response to my inquiries, Mr. Chubb wrote, September 25, 1918: "Replying to your letter of September 17, will say that I really can give you no information regarding the history of the killer whale. I usually have several hounds and frequently go on hunting trips over the glades or prairies and sometimes as far as the bay. It was on one of these trips that I found the first lot of teeth. A few months later I was again at the bay and found the head and skeleton which I sent you. The skeleton was found about 20 miles below Miami on the shore of Biscayne Bay. At this point the bay is very shallow, so a man can walk out into the water a quarter of a mile, and the bottom is of a lime and coral rock formation. The tide always overflows the mangrove swamps that border on the bay. Farther back beyond the mangrove swamp is the big glade or prairie of marl formation that overflows part of the year. But to return to the killer skeleton. I found three different lots of these teeth, all within a half mile of each other, and a mile south of the skeleton. In getting the skeleton for the museum I searched thoroughly and feel sure that I procured all of both large and small bones [such small parts as the detached nasals were among those found], but nothing resembling flippers were in evidence. I can not account for their absence."

It seems probable that at least four individuals of *Pseudorca* were stranded on the shore of Biscayne Bay. The teeth sent by Mr. Chubb, however, do not certainly indicate more than two in addition to the animal whose skeleton was found. The 27 teeth belonging in the skull are slightly worn, each with a flat area, usually 3–5 mm. in diameter, at the apex of the crown. Of the 13 separate teeth, three differ from all the others in the broader, more abruptly truncate form of the base. They appear to be almost unworn at the tip, but the enamel is somewhat imperfect. The other separate teeth represent a much more advanced condition of wear. In all but two, more than half of the crown is gone, and in four the enamel covered portion of the tooth has been eliminated. It is possible that six of these ten teeth represent one individual and four represent another, but I do not feel convinced that such is the case.

Measurements of skulls of Pseudorca.

Locality	Peru.	Lower California.	Venezuela.	Florida.	"N.E. Coast."	No history.
Number	3679	23282	20932	218360	11320	219325
Condylobasal length	......	600	540	590	620	595
Basal length	......	590	585	570	610	580
Occipital crest to tip of beak	......	510	490	485	545	535
Rostrum	......	278	270	270	300	295
Tip of beak to nares	......	360	345	343	385	380
Posterior tooth to apex of maxillary notch	......	60	50	54	63	58
Breadth of beak between maxillary notches	......	195	180±	187	210	177
Breadth of beak at level of posterior tooth	225	188	190±	194	215	174
Greatest breadth of single intermaxillary	65	......	51	54	59	46
Least breadth of single intermaxillary	55	......	51	48	57	50
Interorbital breadth	......	323	290±	304	338	300
Glenoid breadth	......	362	327	348	377	352
Depth of braincase behind nares	......	193	183	197	205	190
Occipital depth	......	228	210	216	223	218
Depth of rostrum at level of posterior tooth	57	......	43	49	56	48
Depth of rostrum at middle of tooth row	47	......	38	42	45	43
Mandible	525	......	......	465	......	495
Coronoid-angular depth	150	......	......	133	......	137
Depth of mandible at level of posterior tooth	67	......	......	60	......	60
Depth of mandible at middle of symphysis	46	......	......	33.5	......	36
Maxillary tooth row (alveoli)	225	......	220	227	230	225
Mandibular tooth row (alveoli)	230	......	......	210	......	225
Sixth upper tooth:						
Greatest height	......	......	......	84.5	92±	......
Greatest diameter	......	......	......	22.6 by 20.4	23 by 27	......
Height from base of enamel	36	......	......	20±	28	......
Diameter at base of enamel	22 by 25	......	......	15 by 14.4	17.6 by 19	......

EXPLANATION OF PLATES.

All figures about one-fourth natural length.

PLATE 27.

Pseudorca crassidens. Florida. Dorsal view of skull.

PLATE 28.

Pseudorca crassidens. Florida. Ventral view of skull.

PLATE 29.

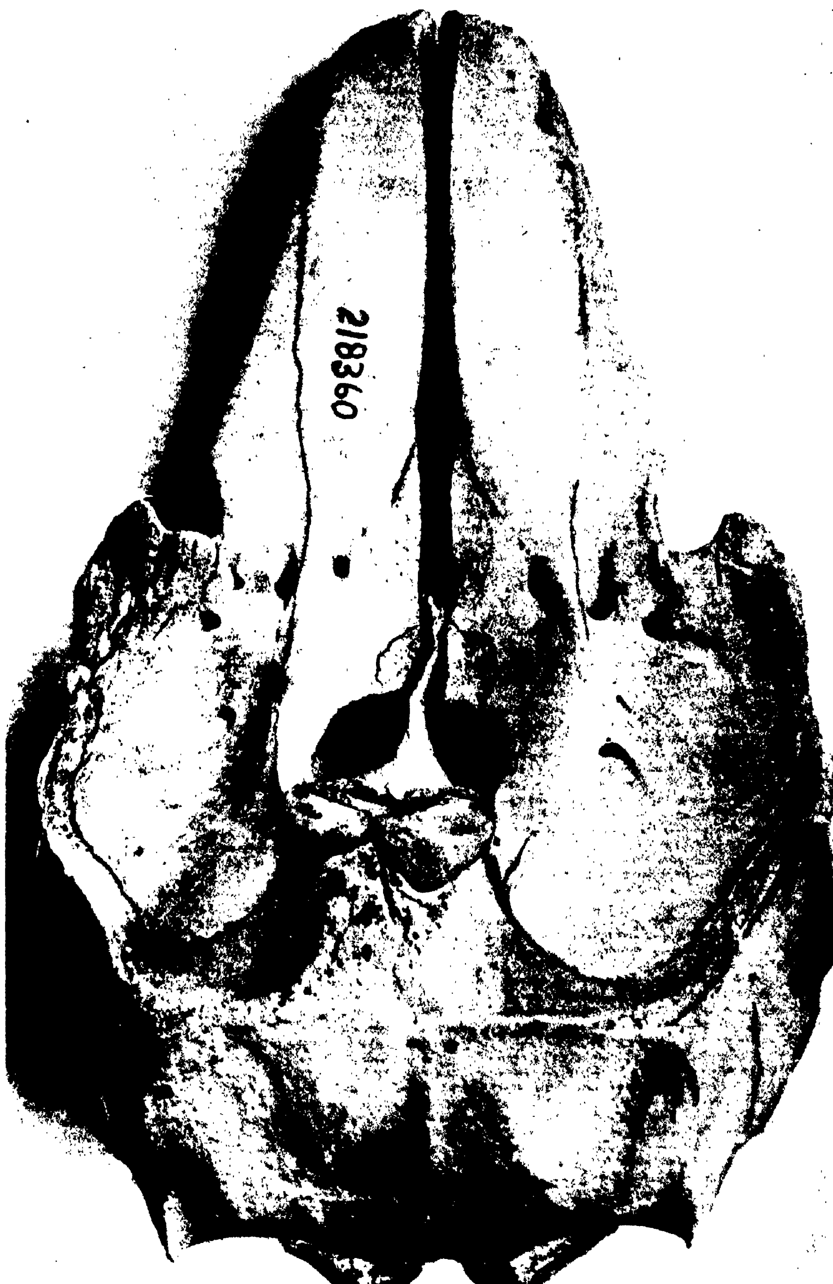
Pseudorca crassidens. Florida. Lateral view of skull.

PLATE 30.

Pseudorca crassidens. Florida. Mandible from above.

PLATE 31.

Pseudorca crassidens. Florida. Mandible from side.

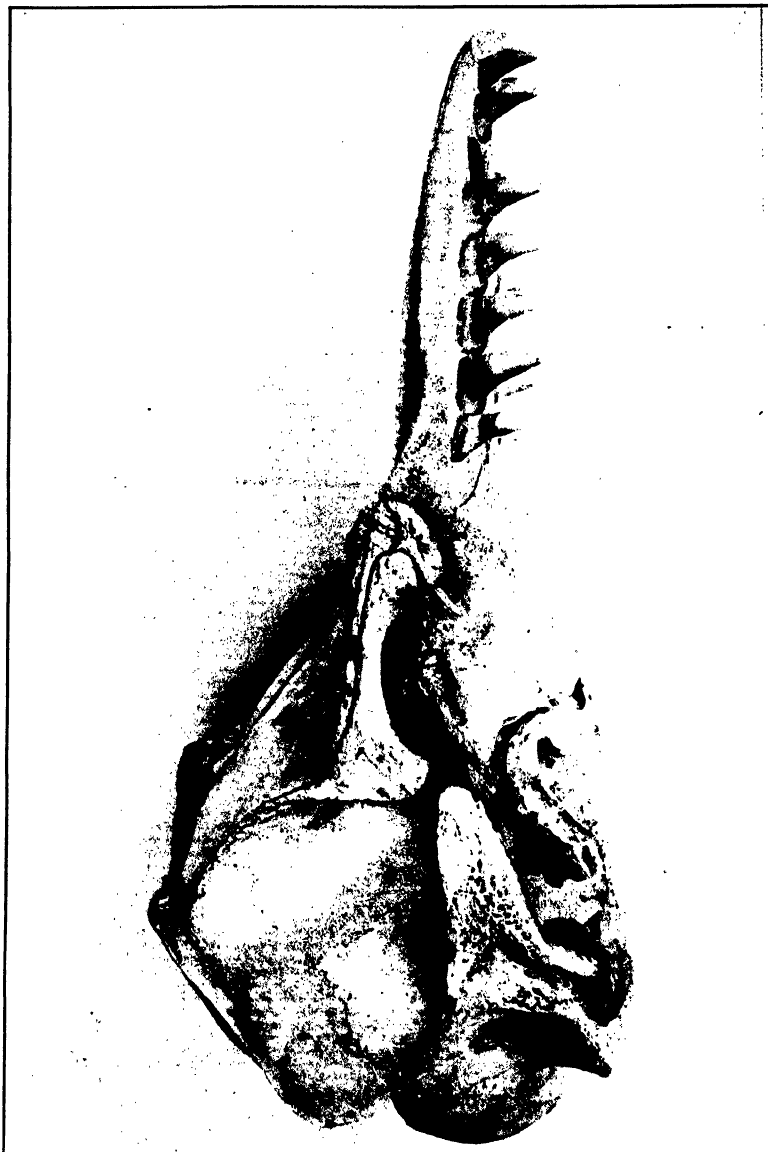


DORSAL VIEW OF SKULL OF PSEUDORCA CRASSIDENS.

FOR EXPLANATION OF PLATE SEE PAGE 207.

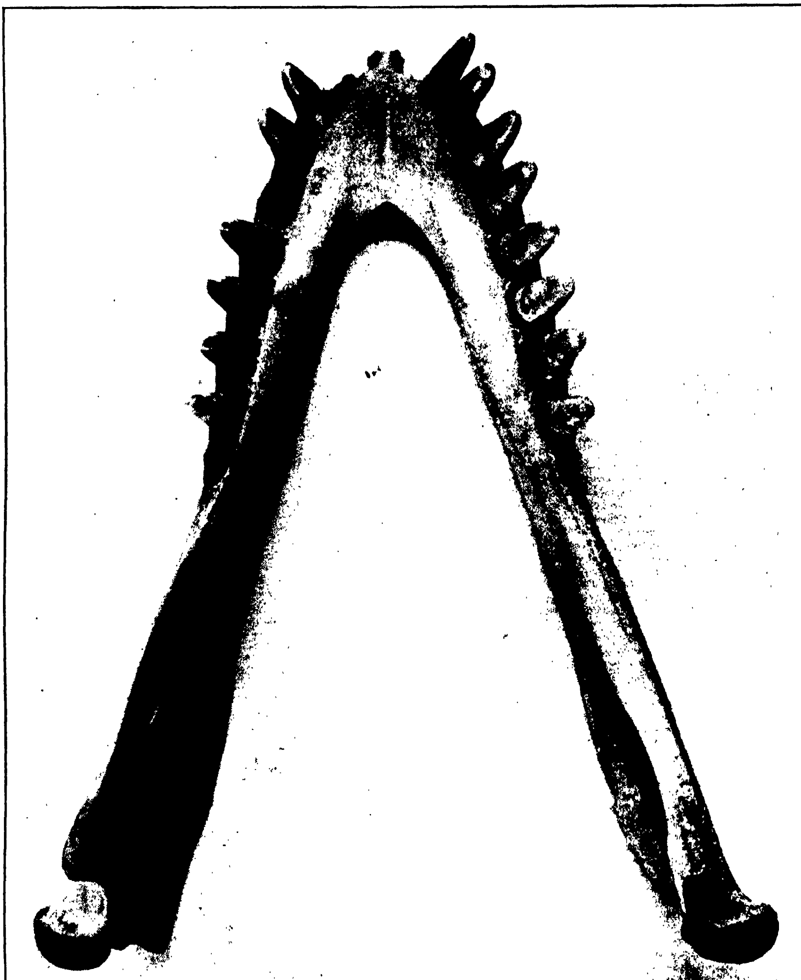
VENTRAL VIEW OF SKULL OF PSEUDORCA CRASSIDENS.

FOR EXPLANATION OF PLATE SEE PAGE 207.



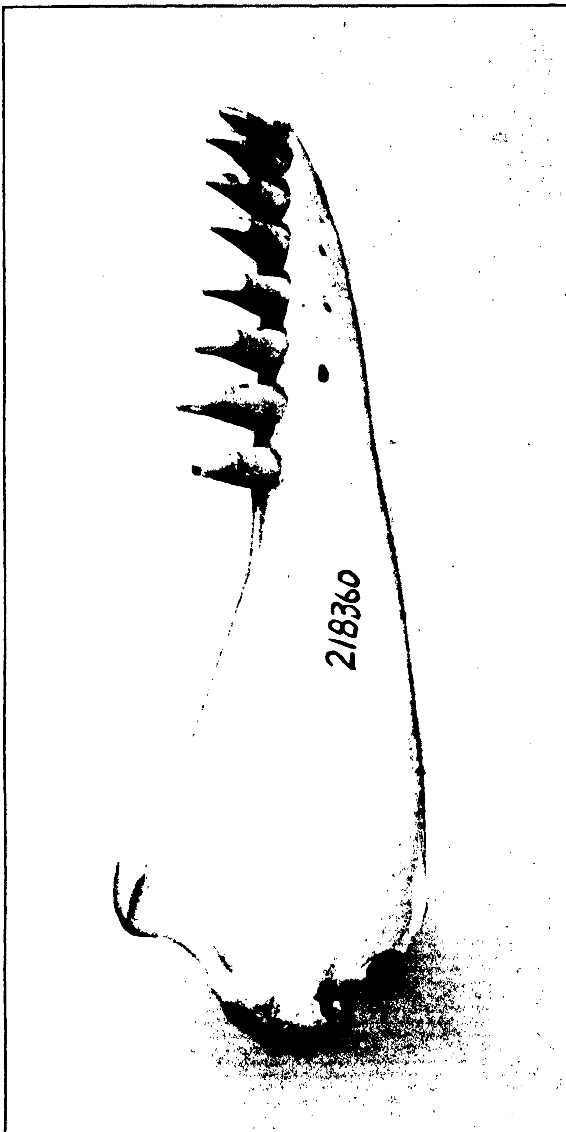
LATERAL VIEW OF SKULL OF PSEUDORCA CRASSIDENS.

FOR EXPLANATION OF PLATE SEE PAGE 207.



MANDIBLE OF PSEUDORCA CRASSIDENS FROM ABOVE.

FOR EXPLANATION OF PLATE SEE PAGE 207.



MANDIBLE OF PSEUDORCA CRASSIDENS FROM SIDE.

FOR EXPLANATION OF PLATE SEE PAGE 207.

DESCRIPTIONS OF TWENTY-FIVE NEW SPECIES OF NORTH AMERICAN HYMENOPTERA.

By S. A. Rohwer,

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The following pages contain the descriptions of 25 new species of Hymenoptera which have been submitted for identification. The types of all the species are in the United States National Museum.

Superfamily MEGALODONTOIDEA.

Family MEGALODONTIDAE.

ITYCORSIA ZAPPEI, new species.

Of the North American species, this new species is probably most closely allied to *maculiventris* (Norton), but the male differs in a number of ways from the description given for that species, and the description of the female given by MacGillivray does not agree in all details with the female of the species described here. In MacGillivray's key to the species of *Itycorsia* of Connecticut (Bull. 22, Conn. Geol. and Nat. Hist. Survey, p. 33) this species runs to couplet 6, but differs from both *luteomaculata* (Cresson) and *albomaculata* (Cresson) in the black cypeus and other minor characters. Of the European species it seems to be more closely allied to *stellata*, but differs from the descriptions of that species in the color of both adult and larva.

Female.—Length 13 mm. Anterior margin of the clypeus truncate; medianly the clypeus is strongly raised by the extension of the antennal carina; its surface is shining, impuncate; median fovea deep, elongate; area above the frontal crest with rather close, small punctures; median ocellus in a diamond-shaped depression; posterior ocellus bordered laterad and caudad by a deep furrow; posterior orbits and vertex shining, with large widely separated punctures, frontal crest obsolete; antennae 31-jointed, the third joint slightly longer than the fourth and fifth combined; prescutum shining, practically impunctate; scutum shining, with a median area of close, large punctures; scutellum shining, practically impunctate; mesepisternum subopaque, with sparse, rather large, setigerous punctures. Black;

spot on the mandibles at base, spot on the superior orbits, two spots on the vortex, spot on the occiput behind the eye, and with a line-like projection toward the supraorbital spot, the posterior margin of the pronotum, tegulae, two spots near the posterior margin of the prescutum, two spots along the notauli on the scutum, two large spots on the scutum posteriorly, a small spot on the lower posterior orbits, an elongate spot on the mesepisternum dorsally, circular spot on the sides of the pronotum, most of the metepisternum, dorsal and ventral margins of tergites, the apical margin of the sternites 3, 4, 5, and 6, *yellowish-white*; legs black; the tibiae and basal joints of the anterior tarsi rufous; wings hyaline basally, fuliginous beyond the basal margin of the stigma; venation dark brown.

Paratype females show that this species may vary as follows: the spot on the metepisternum may be greatly reduced; the line projecting toward the supraorbital spot may be complete or entirely absent; the yellow spot on the lower margin of the posterior orbits is usually wanting.

Male.—Length 8.5 mm. In puncturation and characters of the head, the male agrees with the above description of the female, except the declivous face is a little more sharply defined on the frontal crest, however the frontal crest is rounded and not margined; antennae 31-jointed; the third joint slightly longer than the fourth and fifth; hypopygidium broadly rounded apically. Black and yellow; antennae yellowish-ferruginous, apical half brownish; scape above black; head black; mandibles except apices, clypeus except two points medianly, lateral supraclypeal area, area between the antennae and extending caudad in two lines to the level of the anterior ocellus, the lateral orbits near the top of the eye where they narrow and extend almost to the middle of the occiput, supraorbital spot, connected with the line extending posteriorly to meet the line of the occiput, two spots on the vertex, *yellow;* thorax black, the posterior dorsal margins of the pronotum, tegulae, most of the prescutum, two spots on the scutum anteriorly, spots on the scutum posteriorly, the scutellum, most of the metepisternum, sternum, metepimerun, and episternum, *yellow;* sternites, and tergites ventrally, and the lateral margin of the tergites dorsally yellow; the rest of the tergites black; legs yellow with the base of the coxae posteriorly, line of the femora and trochanters posteriorly black; wings hyaline; venation dark brown; costa and also margin of the stigma yellowish.

Type locality.—New Haven, Connecticut. Described from eight females and two males collected by M. P. Zappe for whom the species is named. The type female was collected as a larva August 2, 1916, on Austrian pine and emerged June 7, 1917. It is recorded under No. 670 Connecticut Agricultural Experiment Station. The type male and the paratype male were collected as larvae on August 2, 1916, on

White pine, and emerged June 26, 1917, and are recorded under No. 669 Connecticut Agricultural Experiment Station. The other females were collected in June and July, 1915.

Type, Allotype, and four female Paratypes.—Cat. No. 21605, U.S.N.M.

Three female paratypes and the male paratype returned to the Connecticut Agricultural Experiment Station.

Superfamily TENTHREDINOIDEA.

Family ARGIDAE.

ARGE MOCSARYI, new name.

Arge apicalis Mocsary, Anal. Mus. Nat. Hung., vol. 7, 1909, p. 6; not (*Hylotoma*) *Arge apicalis* Kirby, 1894.

Family TENTHREDINIDAE.

PERICLISTA PLESIA, new species.

This species is very close to *carycola* (Dyar), but the sheath is obliquely truncate and then broadly rounded to the base; the clypeus has a broad subangulate emargination and the fourth antennal joint is subequal in length to the fifth.

Female.—Length 5.5 mm. Clypeus broadly subangulately emarginate, the lobes broad and rounded on the lateral margins; supraclypeal area gently convex, shining; middle fovea circular in outline, deep with sloping walls; frontal foveae small, elongate; ocellar basin reduced to a triangular depression around the anterior ocellus from which it projects posteriorly to the postocellar furrow; antennal furrows obsolete between the frontal foveae and the postocellar furrow; postocellar furrow well defined; postocellar area convex, faintly impressed medianly, well defined laterally; third antennal joint a little shorter than the fourth and fifth joints; the fourth and fifth joints subequal; vertex and mesepisternum shining; stigma three times as long as its greatest width, obliquely truncate apically; petiole of the anellan cell rather long; sheath straight above, pointed at the tip, obliquely truncate and then rounded to the base. Black; clypeus, labrum, margin of the pronotum, and tegulae, yellowish-white; margin of the prescutum, posterior margin of the scutum, scutellum, anterior part of the pronotum, upper half of the mesepisternum, all of the legs except the extreme bases of the coxae, sternites except the middle of the five basal (narrow on the first to broader on the fifth) rufo-ferruginous; wings hyaline, venation brown, costa and stigma whitish.

Type locality.—Portland, Connecticut. Described from the female collected on white pine on May 15, 1914, by B. H. Walden.

Type.—Cat. No. 21697, U.S.N.M.

PERICLISTA PECANIVORA, new species.

Allied to *Periclista hicoriae* Rohwer but may easily be distinguished by the polished practically impunctate scutum and scutellum (in *hicoriae* with uniform, separated punctures), and by the ventral tooth of the mandibles being long and acute (in *hicoriae* scarcely exceeding upper, blunt and rounded).

Female.—Length 5.5 mm. Mandibles with the lower tooth long and pointed, much exceeding the upper; clypeus with large punctures basally, apically depressed, the apical margin with a shallow arcute median emargination, lobes broad, rounded apically; supraclypeal area not strongly convex, triangular in outline; median fovea oval, deep, with a shallow furrow extending dorsally; antennal furrows shallow, broad; depression around anterior ocellus sharply defined above, open below, triangular in outline; postocellar furrow straight, sharply defined; vertical furrows sharply defined anteriorly, obselete posteriorly; postocellar area convex; postocellar line somewhat longer than ocellocular line; fourth and fifth antennal joints subequal; front with medium size, rather close, setiguous punctures; vertex and temples polished but with a few rather small punctures; entire mesonotum polished, with only a few punctures along the margins of sclerties; mesepisternum polished with only small setiguous punctures; stigma nearly four times as long as greatest width; gradually tapering from base to interradius then sharply oblique; the apical lower abscissa nearly half as long as interradius; interradius very slightly before middle of third cubital; anellan cell sessile; sheath straight above but with apical angle curved upward so there is a narrow projection, from projection gradually rounding to base. Black; apical part of clypeus, labrum, palpi, spot on mandibles basally, angles of pronotum and tegulae whitish; upper half of mesepisternum, margins of prescutum, posterior margin of scutum, a spot on scutellum ferrugineous; abdomen except first tergite (margins of tergites slightly infuscated), and legs except posterior coxae, yellowish ferrugineous; wings hyaline; venation dark brown, costa and stigma yellowish.

Type locality.—San Saba, Texas. Described from two females received from Bureau of Etomology under Quaintance number 16703 and bearing host label "Pecan". Collected April 20, 1918, by A. I. Fabis.

Type.—Cat. No. 22203 U.S.N.M.

PTERONIDEA MELANOSTOMA, new species.

This species runs in Marlatt's key to *pacificus* (Marlatt), but that species has, according to the description, a deep, oval middle fovea and has the characters of the head and the color of the femora different. Although the shape of the sheath suggests species of *Pontania*

the habitus, characters of the head, and antennae are typical of the genus *Pteronidea*.

Female.—Length 5 mm. Robust; shining. Clypeus gently convex, the anterior margin shallowly, arcuately emarginate, the lobes broad and rounded apically; supraclypeal foveae deep, punctiform, not connected with the antennal foveae; supraclypeal area uniform, convex, not sharply defined dorsally but tapeziodal in outline; median fovea shallow, circular in outline; frontal crest broken by an elongate shallow depression which appears as an interrupted extension of the middle fovea; ocellar basin short, sharply defined, shining, trapezoidal in outline; antennal furrows well defined dorsally; postocellar line subequal with the ocellocular line; postocellar area sharply defined anteriorly by the distinct angulate postocellar furrow; a distinct furrow from the anterior ocellus to the postocellar furrow, posterior orbits full, straight; antennae rather short, distinctly tapering, the third joint a trifle shorter than the fourth; inner tooth of the claw shorter than the outer; stigma long, narrow, sharply tapering, fully four times as long as its greatest width; recurrentella distinctly postfurcal; sheath broad, straight above, truncate apically, the truncation slightly emarginate, oblique to a broad base. Black; sides of the nates ferruginous; legs black; trochanters, apices of the femora, all of the tibiae and tarsi, yellowish-ferruginous; wings hyaline, venation dark brown, costa and stigma yellow; head and thorax with short white hair.

Type locality.—St. George Island, Bering Sea. Described from one female collected by G. De Has Hanna, June 14, 1914, and recorded under his lot No. 12.

Type.—Cat. No. 21644, U.S.N.M.

PTERONIDEA ALNIVORA, new species.

This species is closely allied to *Pteronidea corylus* (Cresson) but the scape and the supraclypeal area are black, the middle fovea is broader and more rounded, the lower margins of the lancets have small sharp teeth.

Female.—Length 6 mm.; length of the antennae 4.5 mm. Anterior margin of the clypeus deeply arcuately emarginate, the lobes obtusely rounded, distinctly narrower than the emargination; supraclypeal area uniformly convex, triangular in outline; supraclypeal foveae deep, elongate, confluent with the antennal foveae; middle foveae broad, U-shaped in outline, walls sloping; frontal crest very prominent, broken; ocellar basin hexagonal in outline, open above with the lateral and lower walls high but sloping; postocellar area convex, parted, well defined laterally but only incompletely defined anteriorly; antennae distinctly tapering, the third joint a trifle longer than the fourth; head and thorax shining; stigma short, rounded

below, broadest at about the middle, its length about two and one-sixth times as great as greatest width; third cubital one-fifth wider apically; the second recurrent received one-half the length of the second intercubitus from the apex of the cell; sheath straight above, rounded apically, tapering to a broader base. Black; labrum, angles of the pronotum, tegulae, whitish; abdomen beyond the basal plates rufous; sheath black; legs rufo-ferruginous; the bases of all the tibiae, and the four anterior basitarsis whitish; apices, hind femora, apical two-thirds of hind tibiae, and all of the hind tarsi black; wings hyaline, iridescent, venation brown.

Male.—Length 5 mm. The structural characters of the head agree very well with those of the female; third antennal joint is distinctly shorter than the fourth; stigma as in the female; third cubital cell but little longer than its apical width; hypopygidium subtruncate apically, the sides oblique; procentia projecting by nearly its apical width, truncate. Black; labrum, angles of the pronotum, and tegulae whitish; legs rufo-ferruginous; apices of all the tibiae whitish; the extreme apex of the posterior femora, apical two-thirds of the posterior tibiae, and all of the posterior tarsi, blackish; wings hyaline, venation brown.

Type locality.—Webb Pond, Maine. Described from eleven females (one, type) and two males (one, allotype) reared from larvae collected September 5, 1894, feeding on Alder. Material collected and reared by H. G. Dyar and recorded under his No. 4Q.

Type.—Cat. No. 21794, U.S.N.M.

PTERONIDEA MENDICANA, new species.

This species is closely allied to *mendicus*,but is readily separated by the large size and the different conformation of the head.

Female.—Length 6 mm.; length of the antennae 4.5 mm.; robust. Clypeus deeply, subsquarely emarginate, the width of the emargination much less than the lobes; lobes broadly rounded; supraclypeal foveae punctiform, not confluent with the antennal foveae; supraclypeal area convex, broadly triangular in outline; middle fovea elongate, deeper below, and giving the appearance of being circular; frontal crest indistinctly broken; ocellar basin poorly defined, pentagonal in outline; postocellar area not arched, sharply defined on all sides, straight anteriorly; postocellar line subequal with the ocellocular line; antennae slender, tapering, the third and fourth joints subequal; head and thorax shining; stigma broader at base, sharply tapering to the apex, the greatest width two and one-third times the length; third cubital distinctly longer than its apical width; second recurrent one-half the length of the second intercubitus from the end of the cell; sheath straight above, broad, obliquely truncate apically, gradually tapering below. Yellowish-ferruginous;

antennae, spot inclosing the ocelli, one on the postocellar area, spots on the prescutum, scutum, apex of the scutellum, posterior margin of the scutum, metathorax medianly, all of the tergites medianly, black; legs yellowish; hind tarsi dusky; hind tibiae ferruginous; the color on the ventral part of the body is distinctly paler than on the dorsal part; wings hyaline; costa and stigma pale brown, remaining venation dark brown.

Type locality.—Harrisburg, Pennsylvania. Described from four females (one type) reared from larvae collected on *Salix* and recorded under Bureau of Entomology No. Hopk. U.S. 11398*r*. Material collected by A. B. Champlain and reared by William Middleton.

Type.—Cat. No. 21795, U.S.N.M.

PTERONIDEA AMELANCHIERIDIS, new species.

This species belongs in with *militaris* (Cresson) and *thoracica* (Harrington) but is readily separated from both of these by the black venter. Marlatt confused more than one species both under the name of *militaris* and *thoracica.* The species from *Amelanchier* determined as *thoracica,* however, seems to be correct.

Female.—Length 5 mm.; length of antennae 4.5 mm. Robust. Anterior margin of the clypeus deeply, arcuately emarginate, the lobes narrow and sharply triangular; supraclypeal foveae deep, connected with the antennal foveae; supraclypeal area strongly convex; middle fovea elongate, breaking through the crest; ocellar basin pentagonal, walls rounded; a distinct longitudinal groove extending below the anterior ocellus; postocellar area flat, sharply defined on all sides; postocellar furrow angulate anteriorly; postocellar line a trifle longer than the ocellocular line; head shining; third antennal joint slightly shorter than the fourth; antennae only gently tapering; thorax shining; stigma rounded below, about four times as long as the greatest width; third cubital rectangular in outline, about one half times as long as broad; second recurrent the length of the second intercubitus before the end of the cell; sheath straight above, acute at the apex, sharply oblique to the broad base. Black; angles of the pronotum, mesepisternum, sternum, metasternum, spots on the side of the scutum, and legs to the apices of the femora, rufous; the four anterior tibiae and tarsi, the basal half of the posterior tibiae, white; apical half of the posterior tibiae and all of the hind tarsi, black; wings hyaline, venation dark brown.

Paratypes indicate that the rufous marks on the scutum may be entirely wanting, and the apical joints of the anterior tarsi may be black.

Type locality.—East River, Connecticut. Described from three females (one, type) reared from larvae collected by Charles R. Ely, feeding on *Amelanchier canadensis,* and recorded under Bureau of

Entomology, No. Hopk. U. S. 13649 e[2]. Material reared by William Middleton.

Type.—Cat. No. 3485, U.S.N.M.

PTERONIDEA PLESIA, new species.

This species is closely allied to *Pteronidea salicis-odorata* (Dyar), but the stigma is shorter and distinctly angulate near the base and the emargination of the clypeus is U-shaped and not V-shaped.

Female.—Length 6 mm.; length of the antennae 4.5 mm. Robust. Anterior margin of the clypeus deeply emarginate, the emargination U-shaped, the lobes broad, rounded apically; supraclypeal area triangular in outline, gently convex; supraclypeal foveae punctiform, confluent with the antennal foveae; middle fovea elongate and breaking through the crest by a short narrow channel; frontal crest faintly broken; ocellar basin pentagonal, closed above, the walls well defined; postocellar furrow nearly obsolete; postocellar area broad; postocellar line subequal with the ocellocular line; head, seen from the side, with the anterior margin arched, not angular, antennae distinctly tapering, the third joint a trifle shorter than the fourth; head and thorax shining; stigma distinctly angulate a little before the middle, two and one-third times as long as its greatest width; third cubital cell slightly wider apically and one-fifth longer than the third intercubitus; second recurrent fully one-third the length of the second intercubitus from the apex of the cell; sheath straight above, rounded at the apex and sharply oblique. Yellowish-ferruginous; antennae, head above the frontal crest and between the antennal furrows, scutum, prescutum, scutullum, metathorax medianly, tergites medianly, apex of the sheath, black; legs the color of the body except the apical joints of the four anterior tarsi and apical half of the posterior tibiae and all of the posterior tarsi are black; wings hyaline, iridescent; venation, including the stigma, dark brown.

Type locality.—Westbury, Long Island, New York. Described from three females reared from larvae collected from *Populus tremuloides* and recorded under Bureau of Entomology No. Hopk. U. S. No. 13656*o*. Material collected by A. B. Champlain, and reared by William Middleton.

Type.—Cat. No. 21796, U.S.N.M.

AMAURONEMATUS WHITNEYI, new species.

In Marlatt's key to the species, runs to *orbitalis* Marlatt but it is larger and has quite different characters in the head. It bears a superficial resemblance to *similis* Marlatt, but may be easily distinguished from that species by the pale upper part of the mesepisternum.

Female.—Length 8.25 mm. Robust. Clypeus gently convex, the apical margin with a deep V-shaped emargination, the lobes broad,

triangular in outline; supraclypeal foveae deep, oval, not connected with the antennal foveae; supraclypeal area flat, opaque, trapezoidal in outline; middle fovea large, shallow dorsally, deeper ventrally, the outer margin triangular in outline; ocellar basin poorly defined, the lower and dorsal walls obsolete, the lateral walls reduced to narrow line-like ridges, probably pentagonal in outline; postocellar line distinctly longer than the ocellocular line; postocellar area strongly convex, sharply defined laterally by elongate foveae, and anteriorly by the well defined, curved postocellar furrow; antennae short, not extending beyond the apex of the scutellum, the third joint a trifle shorter than the fourth, strongly curved beneath; stigma long and narrow, broader at base where it is slightly angulate; third cubital cell twice as wide apically as basally, on the radius one-fourth shorter than the second; recurrentella jointing the cubitellan cell the length of the intercubitella basad of the intercubitella; claws deeply cleft, inner tooth slightly shorter than outer; sheath broad, straight above, rounded at the apex, sharply oblique and then gently oblique to the base. Black; clypeus, labrum, mandibles, palpi, supraclypeal area, entire orbits, posterior ones broadly, most of the postocellar area, most of the pronotum, tegulae, posterior margin of the preseutum, anterior half of the scutellum, posterior margin of the scutum, upper half of mesepisternum, *yellowish;* legs black; coxae except basally trochanters, anterior and intermediate tibiae and tarsi, apex of the posterior femora beneath, posterior tibiae, base of the posterior tarsi, yellowish-white; last two tergites and the margins of the four apical sternites yellowish-white; wings subhyaline, venation dark brown, costa and stigma yellowish.

Type locality. St. Paul Island, Bering Sea. Described from one female collected April 15, 1914, by A. G. Whitney, and bears his lot No. 122. Named for A. G. Whitney.

Type.—Cat. No. 21642, U.S.N.M.

PACHYNEMATUS GOTARUS Kincaid.

Females from St. George Island, Bering Sea, collected in June, 1914, by G. Da Has Hanna, at the same time that males of this species were taken seem to be without any doubt the females of this species. In Marlatt's revision they run to *pubescens* Marlatt, but differ from that species in the emargination of the clypeus and other head characters.

Female.—Length 6.5 mm. Robust. Clypeus gently convex, the anterior margin broadly, shallowly, arcuately emarginate; supraclypeal foveae deep, elongate, confluent with the antennal foveae; supraclypeal area opaque, rather strongly convex, triangular in outline; middle fovea deep, punctiform; frontal crest not broken; ocellar basin well defined, triangular in outline, with the lower wall broad;

postocellar line very little shorter than the ocellocular line; postocellar area strongly convex, well defined laterally, almost completely parted by a medium furrow; postocellar furrow nearly wanting; antennae rather short, the third joint a trifle shorter than the fourth; head and thorax shining, covered with long gray hair; posterior orbits straight; second recurrent interstitial or slightly beyond the second intercubitus; third cubital cell short, its length subequal with the apical width; stigma rounded below; recurrentella interstitial with the intercubitella; sheath broad, straight above, pointed apically, then obliquely truncate. Black; clypeus, supraclypeal area, posterior orbits obscurely, mesothorax almost entirely, venter, two apical tergites and legs except infuscate bases of the coxae and femora, rufopiceous; wings subhyaline, venation pale brown, costa and stigma yellowish.

PACHYNEMATUS BOULDERENSIS, new species.

This new species belongs to group III of Marlatt and runs in his key to *pallidiventris* (Cresson) but is to be distinguished from that species by the smaller middle fovea and subequal third and fourth antennal joints. In general appearance it is much like *robustiformis* Rohwer which belongs to group II.

Female.—Length, 6 mm.; length of anterior wing, 6 mm. Anterior margin of the clypeus broadly arcuately emarginate, the lobes triangular and pointed apically; supraclypeal foveae, large, deep, obliquely placed and oval in outline, connected with antennal foveae; supraclypeal area broad, convex; middle fovea small well defined, oval in outline; frontal crest fairly prominent and only slightly broken; ocellar basin pentagonal in outline incompletely defined below; antennal furrows complete, broad, shallow; postocellar line slightly shorter than the ocellocular line; postocellar furrow feeble; postocellar area narrow, with a median impression; temples receding; antennae but little shorter than body, slightly tapering, the third and fourth joints subequal; head with scattered setiguous punctures; thorax shining, practically impunctate; scutellar appendage irregularly aciculate; second recurrent antefurcal by nearly the length of second intercubitus; stigma large, rounded below, two and one-half times as long as broad; sheath straight above, narrowly rounded apically and tapering to a broad base; cerci long slender. Black, narrow apical margin of labrum, palpi, narrow posterior, lateral margin of pronotum, tegulae and ventral aspect of abdomen yellowish; legs black, four anterior coxae beneath, trochanters, apical part (broader dorsally) of anterior femora, dorsal line on four posterior femora, four anterior tibiae and tarsi, basal three-fourths of hind tibiae and base of hind basitarsis yellowish; wings hyaline, iridescent; venation and stigma dark brown, costa yellowish.

Type locality.—Boulder, Colorado. Described from one female collected May 9, 1919, by K. Fitzgerald.

Type.—Cat. No. 22356, U.S.N.M.

PRISTIPHORA BETULAVORA, new species.

This species is closely allied to *murtfeldtiae* Marlatt but may be distinguished from that species by the smooth, polished scutellar appendage and the depressed area latrad of ocelli.

Female.—Length, 5. 5 mm. Supraclypeal area prominent, triangular in outline; middle fovea shallow, oval in outline; antennal furrows indicated only by broad shallow depressions which cause the central area to appear somewhat raised; postocellar line distinctly longer than the ocellocular line; postocellar furrow straight; front punctured, the punctures smaller and more widely separated laterally; vertex and temples polished; antennae tapering, the third joint not much longer than the fourth, the fourth and fifth subequal; scutum with only a few widely scattered punctures; scutellum and appendages smooth, shining; stigma rounded below; first intercubitus wanting; second recurrent about length of second intercubitus from apex of cell; third cubital slightly longer than apical width. Black; palpi in part, narrow apical margin of labrum, tegulae, trochanters, apices of anterior femora, four anterior tibiae and tarsi, basal two-thirds of hind tibiae white; wings hyaline, venation including costa and stigma dark brown.

Male.—Length, 4 mm. Agrees in structure and color with the female; flagellum reddish-yellow beneath.

Type locality.—East River, Connecticut. Described from three (one type) females and one male. Material collected by Chas. R. Ely as larvae feeding on white birch (*Betula alba*) and reared at East Falls Church, Virginia, under Bureau of Entomology numbers Hopk. U. S. 10757*d* (type, allotype and paratype) and Hopk. U. S. 10745*m*.

Type.—Cat. No 22323 U.S.N.M.

Superfamily CYNIPOIDEA.

HEXAPLASTA LUCIDA, new species.

Of the described North American species this new species is more like *H. websteri* Crawford, but may easily be distinguished from it by the different sculpture of the scutellum and longer pedicellum.

Female.—Length 2 mm. Head without sculpture; postocellar line subequal with ocellocular line; pedicellum subequal in length with the fourth joint and only a little shorter than the third joint; general outline of antennae about as in *websteri* but the apical joint is about one-fourth longer than the preceding; apex of elevation of scutellum with a large fovea; basally there are also two large fovea;

scutellum latrad and apicad of elevation closely irregularly punctured; propodeum with short white hair and a low median ridge; hair band on first tergite dense, tawny; first abcissa of radius distinctly shorter than the second. Black; mandibles, joints of legs basally, apices of femora, all tibiae and tarsi rufo-piceous; wings hyaline; venation brown.

Male.—Length 2 mm. Except for usual sexual characters agrees with the description of female; antennae 15-jointed, pedicellum about one-third length of third joint, flagelar joints nearly of uniform thickness and length.

Type locality.—Syracuse, New York. Described from two females and one male reared by M. W. Blackman and H. H. Stage from *Hicoria glabra* and recorded under their numbers H–1820 (type), H-1898 (paratype) and H–1956 (allotype).

Type.—Cat. No. 22028 U.S.N.M.

Superfamily ICHNEUMONOIDEA.

Family ICHNEUMONIDAE.

Genus LISSONOTA Gravenhorst.

The species here described are believed to be congeneric with *Lissonota sulphurifera* Gravenhorst, the genotype of the genus *Lissonota*.[1]

LISSONOTA EVETRIAE, new species.

This species is closely allied to *pleuralis* (Cresson) but may be distinguished by the longer and more finely sculptured tergites and from the typical form by the rufous scutum.

Female.—Length, 6.5 mm. Clypeus shining, the anterior margin broadly rounded; face with distinct separate punctures; vertex, front and scutum similarly but more sparsely punctured; propodeum with punctures similar to those on the face, the apical carina well defined but not specially prominent; tergites long and narrow, the second but little shorter than the first, the third slightly shorter than the second, the first finely obliquely aciculate laterally and in addition to the aciculations with small scattered punctures, without a transverse sculptured depression apically; second tergite with small scattered punctures except just before the apical lateral margins where the punctures are almost confluent; third tergite uniformly, sparsely punctured; areolet sessile; nervulus postfurcal at three fourths its length; nervellus angulately broken below the middle; ovipositor slightly longer than the insect. Black; clypeus, mandibles except apices, spot on inner orbits opposite the ocelli, antennae, spot on the inner superior orbits, the usual spot on the

[1] See Viereck, Bull. 83, U. S. Nat. Mus., 1914, p. 86.

scutum, tegulae, a spot beneath, spot on the sides of the pronotum, anterior coxae and trochanters *white*; mesoscutum spot on the scutellum, mesepisternum beneath, legs except dusky apices of the posterior tibiae and the posterior tarsi rufo-ferruginous; wings hyaline, iridescent, venation dark brown.

Male.—Length, 5 mm. The puncturation of the male is sparser than in the female; otherwise the structural characters of the above apply well to this sex. Black; clypeus, mandibles, face, lower posterior orbits, inner superior orbits, the usual spots on mesepisternum extending back beyond the middle a spot on the sides of the pronotum, oblique line on the mesepisternum, four anterior coxae and trochanters white; legs ferruginous except the dusky spot and the posterior trochanters above, the apices of the hind tibiae and the posterior tarsi which are dusky; wings hyaline, iridescent, venation pale brown. In the male the coloration of the hind coxae varies from the usual ferruginous color through a piceous spot to an entirely piceous coxae.

Type locality.—Cheyenne, Mountains, Colorado. Described from four females (one, type) and five males (one, allotype) recorded under Bureau of Entomology, Hopk. U. S. Nos. 13283*b* (type) and 13295*b*, material collected by J. H. Pollock and reared at the field station at Ashland, Oregon where it was determined that this species is a parasite in the cocoons of *Evetria taxifoliella* Busck.

Type.—Cat. No. 20782, U.S.N.M.

LISSONOTA DIORYCTRIAE, new species.

The sculpture of this species is very similar to that of *pleuralis* (Cresson) but the marking of the abdomen is quite different. All the specimens of the species have the areolet incomplete, that is, the second intercubitus obliterated.

Female.—Length, 5 mm. Clypeus convex, shining the anterior margin narrowly truncate; face and front coriaceous; mesoscutum with close distinct punctures; propodeum with distinct separate punctures, the apical carina well defined and prominent; dorsal aspect of the propodeum with a faint median, longitudinal impression which is not however bounded by a carina; nervulus postfurcal at half its length; nervellus broken below the middle; tergites rather short and coarsely sculptured, the first one-third longer than the second, punctured basally, the apical margin irregularly rufous; second subequal in length to the third, with coarse, close punctures which apically become confluent; the third has punctures uniform but a little more separated than in the second; ovipositor almost as long as body. Black; clypeus, labrum, inner orbits, face except the median line obscurely, the usual spots on the mesoscutum, the four anterior coxae and trochanters white; mesoscutum, mesepisternum, meta-

pleura, scutellum, apical margin of all the tergites and legs, except where mentioned, rufo-ferruginous.

Type locality.—Patrick's Creek, California. Described from two females recorded under Bureau of Entomology Nos. Hopk. U. S. 14265*l* (type) and 14265*f*, material collected by J. M. Miller and J. E. Patterson and reared at the station at Ashland, Oregon, where it was determined as a parasite of *Dioryctria xanthaenobares.*

Type.—Cat. No. 20783, U.S.N.M.

LISSONOTA CONOCOLA, new species.

The species comes close to *incita* (Cresson) and *angusta* (Davis) but may be separated from both these by the different orbital marking and by having the venter mostly black.

Female.—Length, 7 mm. Clypeus very slightly convex, the anterior margins truncate; surface with setigerous punctures; face opaque with a few small poorly defined punctures; front, mesoscutum with well defined separated small punctures; mesepisternum more sparsely punctured; propodeum punctured similarly to the mesoscutum, the apical carina very prominent; nervulus postfurcal at one-fourth its length; nervellus angulately broken below the middle; tergites rather short, the first slightly longer than the second with close small punctures, basally just before the apical margin it becomes rather coarsely striato-punctate; second tergite opaque with small poorly defined punctures, before the apical lateral margins striato-punctate; the third and fourth tergites uniformly rather coarsely sculptured; ovipositor as long as insect. Black; apical part of clypeus, mandibles except apices, small spot on the mesoscutum and tegulae white; legs rufo-ferruginous, the posterior tibiae and tarsi dusky; wings hyaline, venation dark brown.

Male.—Length 6.5 mm. Puncturation not as coarse as in the female and the dorsal aspect of the propodeum has an indistinct longitudinal median depression. Black; clypeus mandibles except apices, face except three projections above, spot on the superior orbits, anterior lateral margins of the scutum, tegulae, an irregular line on the mesepisternum, four anterior coxae and trochanters white; the rest of the legs except dusky posterior tibiae and tarsi rufo-ferruginous.

Type locality.—Mineral King, California. Described from two females and two males recorded under Bureau of Entomology No. Hopk. U. S. 13296*e* which refers to a note stating that these are parasitic on some insect living in the cones of *Abies shastensis*, material collected by F. P. Keen.

Type.—Cat. No. 20784, U.S.N.M.

EXOCHUS (TRICLISTUS) EVETRIAE, new.

Structurally this species is very close to *annulicrus* Walsh but is readily separated from that species by the black coxae. In Davis' review of the Tryphoninae this species goes to *congener* Holmgren but is very easily distinguished from that species by the emarginate occiput.

Female.—Length, 6 mm. Face shining with distinct, large, separated punctures; front and vertex of orbits impunctate; inner margins of eyes nearly parallel; first joint of the flagellum a little shorter than the two following in length; occiput emarginate; mesoscutum and scutellum shining, with sparse setigerous punctures; propodeum shining, with a few setigerous punctures; costulae wanting; the paired longitudinal carinae diverging at the basal third indicating an areola; areolet wanting; nervulus postfurcal by a little more than half its length; abdomen shining, with distinct widely separated punctures which are closer to the middle. Black; tegulae brownish; legs below the trochanters, except the dusky posterior tibiae apically and their tarsi, rufo-ferruginous; wings hyaline, venation pale brown, stigma dark brown.

Type locality.—Butte Falls, Oregon. *Paratype locality:*—Grant Pass, Oregon. Described from two females recorded under Bureau of Entomology Nos. Hopk. U. S. 12530*d* (type) and 12556*ca*, material collected by J. M. Miller and P. D. Sargent, and reared as a parasite of the pupae of *Evetria taxifoliella* (paratype) and *Evetria siskiyouana* (type) at the laboratory at Ashland, Oregon.

Type.—Cat. No. 20785, U.S.N.M.

MESOLEIUS ARTICULARIS Davis.

The following notes made from the type by R. A. Cushman may be useful in assisting in the identification of this species:

Length, 6 mm. Posterior orbits straight; malar space subequal with the width of the mandible at the base; eyes much shorter than the width of the face and with their inner margins parallel; only the clypeus and mandibles yellow; first tergite two thirds as wide as long; all of the coxae nearly entirely black; hind tibiae yellow, reddish at apex; hind tarsi reddish.

MESOLEIUS GYMNONYCHI, new species.

This species according to Davis' classification is more closely allied to *articularis* Davis than to any other species, but the type of the new species has been compared with the type of Davis' species by Mr. Cushman and the following essential differences are noted: Smaller; posterior orbits rounded; malar space one-half the width of the mandible; length of the eyes equal to the width of the face, their inner

margins converging below; face in the middle yellow; first tergite one-half as wide as long; color of legs different.

Female.—Length, 4 mm. Head opaque, finely granular; postocellar line slightly shorter than the ocellocular line; inner margins of the eyes distinctly converging below; length of the eyes subequal with the width of the face below the antennae; apical margin of the clypeus rounded, very slightly depressed; thorax shining, practically impunctate; propodeum shining, with irregular puncturation along the dorsal carinae; tergites shining. Black; mandibles except apices, clypeus, a large spot in the middle of the face, apex of the scape beneath, tegulae, a spot before, the narrow apical margins of tergites 2 and 3, *yellow;* posterior coxae the apices of the first trochanter, apical third of the posterior tibiae, posterior tarsi except a narrow ring at the base, black; wings hyaline, iridescent, vanetion pale brown; costa and stigma slightly darker.

Type locality.—Wenatchee, Washington. Described from one female reared April 24, 1915, as a parasite of *Gymnonychus californicus* Marlatt by E. J. Newcomer, and reported under Bureau of Entomology No. Quaintance 11416.

Type.—Cat. No. 21641, U.S.N.M.

Genus EXENTERUS Hartig.

An examination of the species placed by Davis [1] in the genus *Picroscopus* and a comparison of them with the genotype of *Exenterus* shows that they more properly belong to *Exenterus*. The writer is of the opinion that, if the characters offered in the tables to separate *Picroscopus* from *Exenterus* are the only differences, the genus *Picroscopus* should be suppressed and considered as a synonym of *Exenterus* Hartig.

The American representatives of the genus *Exenterus* make two well defined groups. The first group is represented by a single species, *lophyri* Viereck; the second contains the rest of the American species all of which are closely allied. *Exenterus hullensis* Provancher is not represented in the United States National Museum collection and is not included in the following table. When examining the type of this species I stated that the claws were not at all pectinate and that it would run to the genus *Anecphysis* in both Ashmead's and Davis' tables. An examination of the genotype of *Anecphysis* shows that *hullensis* does not belong there, and since all other characters agree very closely with *Exenterus* it is believed that the observation on the claws may be an error and that there are a few short teeth at the base. according to the notes and the original description of *hullensis* it may be separated from the other American species by the oblique depressions on the second tergite.

[1] Trans. Amer. Ent. Soc., vol. 24, 1917, p. 229.

TABLE TO THE SPECIES.

1. Propodeum uniformly sculptured; first and second tergites sculptured like the following .... *lophyri* Viereck.
   Propodeum more coarsely sculptured medianly; first and second tergites more coarsely sculptured than the following .... 2.
2. Third antennal-joint distinctly shorter than the fourth and fifth; carinae of the first tergite short, extending but a short distance beyond the middle; shining gastroceli of the second tergite indistinct; four anterior femora partly black .... 3.
   Third antennal joint subequal with the fourth and fifth; the carinae of the first tergite extending much beyond the middle; shining gastroceli of the second tergite distinct .... 4.
3. Vertex and scutum closely punctured; face mostly yellow; sculpture on the first two tergites very coarse; stigma more than three times as long as broad. *canadensis* Provancher.
   Vertex and scutum with distinct well separated punctures; face mostly black-sculpture of the first two tergites not nearly as coarse; stigma a little more than twice as long as broad .... *nigrifrons* Rohwer.
4. Four anterior femora pale; second tergite with very coarse punctures which are mostly confluent .... *diprioni* Rohwer.
   Four anterior femora mostly black; second tergite not as coarsely sculptured and more of the punctures distinct .... *affinis* Rohwer.

EXENTERUS LOPHYRI Viereck.

In describing this species Viereck gave as host *Lophyrus townsendi* but it should be corrected to *Neodiprion* (*Zadiprion*) *grandis* (Rohwer).

EXENTERUS CANADENSIS Provancher.

Allotype female in the second Provancher collection, public museum, Quebec, bearing a yellow label with No. 953; in good condition.

Type.—Male is not in the public museum, Quebec, and has not been examined.

EXENTERUS AFFINIS, new species.

Female.—Length, 8 mm. This species is very like *diprioni* and except for the characters mentioned in the foregoing table the description of *diprioni* applies equally well to this species.

Type locality.—Maine. Described from a single female recorded under Bureau of Entomology No. Hopk. U.S. 12070*f*, and reared from a cocoon of a species of *Neodiprion* sent in by a correspondent as feeding on *Pinus resinosa*. The specimen issued May 18, 1915.

Type.—Cat. No. 21060 U.S.N.M.

EXENTERUS NIGRIFRONS, new species.

This species is closely allied to *canadensis* but the characters given in the foregoing table show the differences between the two species.

Female.—Length, 8.5 mm. Face with close confluent punctures; frons shining with distinct well defined punctures; strong semicircular depressions around the ocelli; area between the ocelli and the

eyes impunctate; postocellar line subequal with ocellooccipital line and ocellocular line; pronotum impunctate dorsally, sparsely punctured laterally; mesonotum shining with distinct well defined punctures which are separated by the width of a puncture; propodeum coarsely sculptured in the middle, sides with the punctures distinct, close but not confluent; petiolar area well defined; first tergite one and one-fifth times as long as apical width, parallel sided, the carinae terminating approximately at the middle, coarsely confluently punctured; second tergite with coarse confluent punctures; the third and following tergites shining with the punctures separated by about one-half their width. Black; spot on the mandibles, most of the clypeus, two spots in the middle of the face, scape beneath, inner orbits narrowly, posterior orbits on the lower half, spot on the side of the pronotum, part of the tegulae, spot beneath, the usual spot on the scutum, most of the scutellum, the metanotum, two small spots on the propodeum, apical margin of the first, second, third, fourth, fifth, and sixth tergites (from the second to sixth the band is present only medianly) *yellow*; legs black; trochanters, four anterior femora beneath, four anterior tibiae and tarsi, basal two-thirds of the hind tibiae and most of the hind tarsi yellow; wings dusky hyaline, venation brown.

Type locality.—Washington, District of Columbia. Described from a single female collected May 28.

Type.—Cat. No. 21061, U.S.N.M.

EXENTERUS HULLENSIS Provancher.

Type.—In Harrington collection bearing label P. 581.

Paratypes of this species are in the second Provancher collection public museum, Quebec, bearing blue lable 468 and yellow lable 1238.

FAMILY BRACONIDAE.

CARDOCHILES THERBERIAE, new species.

Apparently allied to *C. thoracica* (Cresson) but the head is darker, the legs and thorax differently marked.

Male.—Length, 5 mm. Head smooth and shining; inner orbits slightly converging below; ocelli in an equilateral triangle; eyes hairy; flagellum distinctly tapering apically, the first joint about one-fifth longer than the fourth; thorax smooth, polished; notauli feebly foveolate; propodeum roughened, the median area well defined, diamond-shaped; abdomen smooth, polished; first abcissa of radius half as long as second and slightly shorter than third which is subequal in length with the second intercubitus. Black; thorax and propodeum ferruginous; clypeus, inner obits narrowly, elongate spot on posterior orbits dorsally, anterior legs below middle of femora, apices of intermediate femora, basal two-thirds of their tibiae, all of

their tarsi and middle of first tergite yellowish-ferruginous; wings uniformly dark brown, venation, including stigma, black.

The paratype has the head almost entirely black.

Type locality.—Sabino Basin, Santa Catalina Mountains, Arizona. Described from two males collected August 28, 1918, on foliage of *Therberia* by C. H. T. Townsend.

Type.—Cat. No. 22033 U.S.N.M.

MICROTYPUS DIORYCTRIAE, new species.

This species agrees very well with the generic description given by Ratzeburg and his figures of the wing venation. It is the first American species to be described in this genus.

Female.—Length, 5.5 mm. Head shining; the face with a few scattered punctures; supraclypeal foveae deep, punctiform, anterior margin of the clypeus rounded; the posterior orbits much narrower than the diameter of the eye; third and fourth antennal joints subequal; ocelli prominent; postocellar line subequal with the ocellocular line; mesoscutum polished; notauli well defined, finely foveolate; depression in front of the scutellum with one prominent median carina and a number of short rugae; lateral areas of the propodeum shining, impunctate; apical dorsal middle and the posterior face reticulate, the sides polished, impunctate with a distinct median carina which becomes weaker posteriorly and divides; mesepisternum polished; legs long, slender; stigma large, triangular, the radius leaving it beyond the middle; the first abscissa of the radius not quite half as long as the second; nervulus postfurcal about half its length; abdomen as long as the head and thorax together; the first segment longitudinal, aciculate; the base of the second tergite with a few aciculations; the third and remaining segments polished, impunctate; lateral margins of the second and base of the third depressed; ovipositor as long as the body. Ferruginous; the sides of the scutellum, metanotum, propodeum, most of the mesepisternum, the first, apical margin, the third, most of the fourth and all of the following tergites black; antennae and flagellum black; wings hyaline, iridescent, venation dark brown, stigma slightly paler at base.

Male.—Length 4.5 mm. The structure of the male agrees with the female except the lateral areas of the propodeum have a few punctures. Black; head except the interocellar area, scape, pronotum, legs except the dusky posterior tarsi and bases of the hind tibiae, the second and third abdominal segments rufo-ferruginous; wings hyaline, iridescent, venation dark brown. The extent of the black on the mesepisternum and abdomen varies considerably and it may be expected that specimens with more black than the description calls for will be found.

Type locality.—Patricks Creek, California. Described from four females and two males recorded under Bureau of Entomology No. Hopk. U. S. 14265*f*, material collected by J. M. Miller and J. E. Patterson and reared at the station at Ashland, Oregon, where it was determined to be a parasite of *Dioryctria xanthaenobares.*

Type.—Cat. No. 20794, U.S.N.M.

Superfamily MUTILLOIDEA.

ELIS EPHIPPIUM (Fabricius).

Tiphia ephippium FABRICIUS, Syst. Ent., p. 775, p. 353.
Plesia ephippium JURINE, Nouv. Meth., 1807, p. 152.
Elis ephippium TURNER, Proc. Zool. Soc., 1912, p. 724.
Elis xanthonotus ROHWER, Proc. U. S. Nat. Mus., vol. 49, 1915, p. 234.

I am much indebted to Mr. Rowland E. Turner for pointing out this synonymy. The only excuse for it is the erroneous treatment of *Tiphia ephippium* Fabricius given in Dalla Torre's catalogue.

PEDINASPIS (PSORTHASPIS) PORTIAE, new species.

Allied to *contiguus* (Cresson) but readily distinguished by the dense red hair on the thorax.

Female.—Length, 18 mm. Anterior margin of the clypeus gently rounded; no impressed line below anterior ocellus; ocelli in a low triangle, the posterior ones well below the supraorbital line, postocellar line more than twice as long and the intraocellar line but about one-fourth shorter than the ocellocular line; third antennal joint only slightly longer than the fourth; posterior margin of the pronotum gently arcuately emarginate; posterior face of the propodeum with strong transverse wrinkles; first two abcissae of radius of subequal length and distinctly shorter than the third which is somewhat shorter than the fourth; nervulus postfurcal, curved. Black with bright reddish appressed hair on head, pronotum, mesonotum, tegulae, base of scutellum and abdomen beyond basal third of second segment; basal abdominal segments with a faint purplish tinge; wings uniformly blackish; venation black; legs, antennae and mandibles black.

Type locality.—Sabino Basin, Santa Catalina Mountains, Arizona. Described from one female collected September 17, 1918, on *Therberia* by C. H. T. Townsend.

Type.—Cat. No. 22032 U.S.N.M.

Superfamily SPHECOIDEA.

DIODONTUS CORUSANIGRENS, new species.

In Fox's key[1] to the North American species of *Psen* this species runs in with *cylindricus* and *mixtus* but the smooth scutum, carinae on the face and venation will readily distinguish it from both of these.

[1] Trans. Amer. Ent. Soc., vol. 25, 1898, p. 3.

Male.—Length 6 mm. Clypeus gently convex, the anterior margin with two distinct teeth medianly which are separated by an arcuate emargination; base of the clypeus and the face below the carina finely aciculate over a finely granular surface; face strongly elevated below the antennae, the vertical margin of the elevation bounded by a sharp transverse carina which is notched dorsally at the middle and does not reach the inner eye margin; seen from in front this elevation has two strong median carinae which converge and unite a short distance before the transverse carina which they join at the median notch; hes e carinae also converge and unite a short distance above the antennae and extend dorsally as a strong carina to the anterior ocellus; front, vertex and posterior orbits shining with widely separated small punctures; ocelli in a low triangle, the postocellar line subequal with the ocellocular line; antennae short, stout, slightly thickening apically, third joint slightly longer than fourth and twice as long as pedicellum; pronotum with a sharp transverse carina anteriorly but not dentate laterally; scutum and scutellum shining, with a few widely separated small punctures; suture between scutum and scutellum strongly foveolate; metanotum punctured like the scutellum; propodeum with the basal inclosure with strong rugae which become transverse posteriorly; dorsally the rest of the propodeum is polished, impunctate; posterior aspect of the propodeum finely transversely rugulose on a granular surface on each side of the deep median channel; meso and metapleurae polished practically without sculpture; the oblique suture on mesepisternum foveolate; sides of propodeum sculptured like the posterior aspect; legs rather short; longer calcaria of hind tibiae curved and subequal in length with the hind basitarsis; petiole trisulcate dorsally, subequal in length with the rest of the first tergite, shorter than the hind femora; abdomen shining, impunctate; first and third abcissae of radius subequal fully three times as long as the second abcissa; first recurrent closer to the base of the second cubital than the second recurrent is to the base of the third cubital; hind wings normal. Black; rather sparsely clothed with silvery hair; wings hyaline, iridescent; venation very dark brown.

Type locality.—St. Louis, Missouri. Described from one male collected July 6, 1918, by Phil Rau and forwarded under his number 3584.

Type.—Cat. No. 21990 U.S.N.M.

TRYPOXYLON PLESIUM, new species.

This species belongs to the group of *frigidum* and is closely related to *frigidum* Smith, but may be separated from that species by having the propodeum reticulate dorsally instead of with uniform oblique striae.

Female.—Length, 8 mm. Anterior margin of the clypeus with a narrow median projection which is very feebly emarginate; a distinct

prominent carina between the bases of the antennae; frontal impressed line incomplete; ocellocular line less than one-half the length of the postocellar line; scutum opaque, finely, rather closely, punctured with smaller indistinct punctures in the interspaces; scutellum more sparsely sculptured, not impressed; propodeum without a median carina dorsally, the surface reticulate, with a few prominent ridges basally; mesepisternum shining, finely granular; sides of the propodeum with uniform oblique striae. Black; tibial spurs whitish; apical joints of the tarsi slightly reddish; wings hyaline, iridescent, with the apical margin dusky, venation dark brown.

Type locality.—St. Louis, Missouri.

Paratype locality.—Northern Illinois. Described from two females from the type locality, the type Rau No. 3135, the paratype under Rau No. 2337; and three females from the paratype locality.

Type.—Cat. No. 21611, U.S.N.M.

CERCERIS RAUI, new species.

The female of this species looks very much like *bicornuta* Guérin, but the clypeus extends forward as a free plate. The general structure of the clypeus is similar to that of *frontata* Say, but the darker body color and darker wings readily separated this from Say's species.

Female.—Length, 20 mm. The median prominence of the clypeus free, projecting at an angle of about 30 degrees from the front; the anterior margin deeply, arcuately emarginate, the lobes narrow, triangular; this frontal projection is one-third wider than its greatest length; the apical margin with dense yellowish hair; face and posterior orbits with large, close punctures; superior orbits and vertex shining with large, separate punctures; sides of the pronotum with a few rugae, the anterior one much stronger; mesepisternum punctato-reticulate with small punctures in the interspaces; mesoscutum with large, irregular, sometimes confluent punctures and with smaller intermediate punctures posteriorly; scutellum with scattered punctures; propodeal inclosure finely granular (under high magnification) with a few large, sparse, well-defined punctures; first tergite with a median depression posteriorly; abdomen with large separate punctures; the fourth and following segments with smaller, somewhat more widely separated punctures; pygidium truncate apically, apical and basal width subequal; sides slightly rounded so the margin width is somewhat greater; sides with a strong fringe of reddish hair. Black and ferruginous; head ferruginous, with clypeus, spot between the antennae and spot on the posterior orbits above yellow; the middle of the face, frons, and a supraorbital spot black; antennae black with the basal four joints and following three joints beneath rufo-ferruginous; thorax black; pronotum dorsally, two large spots

on the propodeum rufo-ferruginous; two small spots on the pronotum, tegulae, two spots on the scutellum, and the postscutellum yellow; abdomen ferruginous with the sutures black; the apical margin of the second, third, and fourth segments yellow; the bands on the second and third segments much broader laterally; legs rufo-ferruginous the four anterior tibiae, posterior femora beneath and the posterior tibiae yellowish; body densely clothed with long gray hair; wings violaceous, venation black; stigma ferruginous.

Paratype females indicate that the species may vary as follows: Black of the head entirely replaced by ferruginous; there may be two yellow marks in the superior orbits to the middle of the vertex; the black of the mesothorax may be largely ferruginous; when the black is replaced by ferruginous, the yellow spots are somewhat larger.

What may be the male of this species is closely allied to *venator* Cresson, but the first tergite is red and the hind basitarsis is straight. In these two characters it is similar to *mimica* Cresson, but differs from that species in the longer apical joint of the antennae.

Male.—Length, 17 mm. Anterior margin of the clypeus with broad, hairy lobes, medianly tridentate; front and face shining, with distinct separate punctures; third antennal joint distinctly longer than the fourth; apical joint of the antenna longer than the preceding, strongly concave beneath, truncate apically; the sculpture of the thorax is similar to that of the female, except that the propodeal inclosure in entirely smooth and polished medianly, but with the large scattered punctures laterally; pygidium truncate apically, strongly margined laterally, and about one-fourth broader at the base than at the apex. Black; face and clypeus, two spots on the pronotum, tegulae, metanotum, bands on the second, third, fourth, fifth, and sixth tergites (those on the second and third much broader laterally) yellow; basal three joints of the antennae and first tergite rufo-ferroginous; legs rufo-ferruginous; intermediate coxae and trochanters beneath, the posterior coxae and trochanters, base of the femora beneath, all of the tibiae beneath and most of the tarsi yellow; body densely clothed with long gray hair; wings subhyaline, the apical margin strongly dusky, venation dark brown costa and stigma ferruginous.

Type locality.—Near St. Louis, Missouri. The type is under Phil Rau's No. 3304; the allotype (male) in under his No. 3259; two paratypes (females) from Lake view, Kansas are under Phil Rau, No. 190. All the material was collected by Phil Rau, for whom the species is named.

Type.—Cat. No. 21610, U.S.N.M.

EOCENE INSECTS FROM THE ROCKY MOUNTAINS.

By T. D. A. Cockerell,
Of the University of Colorado, Boulder.

The insect fauna of the Rocky Mountain Eocene is of peculiar interest and importance. We know very little of the insects of the later Mesozoic. From the Cretaceous, excluding objects regarded as egg-masses, galls, etc., we have records of nineteen species of insects, of which four are North American, coming from Manitoba, Montana, Colorado, and Tennessee respectively. Of the nineteen Cretaceous species, no less than fourteen are Coleoptera, the others being referable to the Homoptera (Cicadidae and Fulgoridae). Trichoptera, Blattoidea, and Odonata. No doubt the modernization of insects and the development of most of the existing families took place during the later part of the Mesozoic, but we have so little knowledge of the in ect-fauna that we can only infer what may have taken place. Below the Cretaceous, we find Locustidae (sens. lat.), Gryllidae, Gomphidae, Epallagidae, Mycetophilidae, Bibionidae, Psychodidae, Tipulidae, Nemestrinidae, Nepidae, Belostomidae, Naucoridae, Notonectidae, Corixidae, Fulgoridae, and Jassidae; that is to say, families of Orthoptera, Odonata, Diptera, Heteroptera, and Homoptera which are still living. The numerous Coleoptera are also doubtless at least in part referable to existing families. Thus the Mesozoic insects are very modern in appearance when compared with those of the Paleozoic; but it is not until we come to the Eocene that we find an extensive fauna of essentially modern type, including a number of genera still living. The records of Eocene insects, outside of the Rocky Mountains, are very few. Eleven, nearly all beetles, are recorded from Greenland; one beetle from Grinnell Land; seven species from Italy; four from England;[1] 23 species altogether. An odonatid larva (*Austrolestidion duaringae* Tillyard) from Australia is perhaps Eocene, possibly Cretaceous. Thus, were it not for the Rocky Mountain Eocene, we should be without a satisfactory Tertiary insect-fauna lower than the Oligocene, the time of the Baltic amber. From the Eocene rocks, generally classed as of Green River

[1] Since this was written I have received and described twenty-seven additional British Eocene insects. The material belongs to the British Museum.

age, in Colorado, Wyoming, and Utah, no less than 244 species of insects have been described, the great majority by Scudder.[1] In the present paper 35 are added, bringing the total to 279. This is an extensive series, but is but a beginning. Hundreds of additional specimens have been collected, mainly by Scudder and Winchester, and from their reports it is certain that many thousands could readily be obtained. It is true that the great majority of specimens remaining unidentified are small, obscure or imperfect; but while many will have to be discarded, diligent study will greatly increase the list of species, especially among the beetles. New collections will always contain only a small percentage of really fine specimens, but where the materials are so abundant, many beautiful things may be confidently expected. The best of the Eocene insects are as well preserved as those of Florissant, with the spots and other markings clear and distinct.

The time has not yet come for a detailed summary of the Rocky Mountain Eocene insect fauna, but a few points may be noted. We have as yet no really large insects (the largest are dragon-flies), and the specimens average smaller than at Florissant (Miocene) or in the existing fauna. Beetles are very numerous, especially the Otiorhynchidae (Brachyrhinidae or Psallidiidae), with 32 species. There are in all 119 Coleoptera described. Orthoptera are represented by five species, Odonata by seven. No Lepidoptera have been found; two specimens which looked like moths proved on close examination to be Trichoptera. Diptera are numerous, and include some of the higher families, such as Syrphidae, Anthomyiidae, Oestridae, etc. Several Dipterous genera are identical with those now living. The Hymenoptera are mostly parasitic, including very characteristic Ichneumonidae and Braconidae. No bees have been found. The most striking feature is the abundance of Fulgoridae (26 species), many of these broad-winged and moth-like, elegantly spotted or banded. These Fulgorids have a tropical facies, and closely resemble those now living in the Indo-Malay region. It is noteworthy that 19 species of Fulgoridae are recorded from the Jurassic, so the family is evidently not only ancient, but its diversification took place very early. There was formerly a difference of opinion between H. Osborn and Kirkaldy as to whether the Fulgoridae were primitive or represented a more modern specialization of the Homopterous type. The paleontological evidence certainly appears to favor Osborn's view, but it must be said that they became highly specialized at a relatively early date. In the Rocky Mountain Eocene landscape, gay and

[1] Five species of beetles come from the Lower Eocene of North Park, Colorado. They are represented by elytra only, and occur in the Coalmont formation.

pretty Fulgoridae must have flitted about in abundance, looking like moths. If there were also genuine moths and butterflies, they must have been rather scarce, or some would have been found among the hundreds of specimens examined. There is somewhat of a mystery surrounding the ants, which certainly did not abound as they did at Florissant. Scudder described a few species, but from very poor materials. I have before me a few supposed ants, but in no case can the precise characters be made out. A really satisfactory Eocene ant is still lacking.

From the typical Green River beds of Wyoming about 140 species of insects are known. Although the Colorado-Utah series is assigned to the Green River [1] it can hardly be contemporaneous with the Wyoming rocks, as the insects of the latter are essentially distinct. Only fifteen species are at present recognized as common to the Wyoming Green River, and the Colorado-Utah series. These are five Curculionidae, six Otiorhynchidae, two Calandridae, and one each of Sciomyzidae (Diptera) and Formicidae. It is not certain that closer scrutiny and better materials will not rather decrease than increase these numbers. Of course it is possible that the differences may be due in part to different ecological conditions, though there is no distinct evidence pointing in this direction.

It must also be added that the several localities in the Colorado-Utah field are probably not all contemporaneous, and it is very likely that we may eventually recognize a number of distinct horizons.

Dr. F. H. Knowlton writes me that he has looked over Mr. Winchester's fossil plants from the Cathedral Bluff region, and although he has not had time to examine them minutely, very few seem to be identical with those of the Wyoming Green River. Most of the species are apparently new. Doctor Knowlton is also convinced that there are several distinct horizons represented in Mr. Winchester's material. The insects now described come from two sources. In recent years Mr. Dean E. Winchester obtained a fair collection, rich in new species, while investigating the oil shales for the United States Geological Survey. Much earlier Dr. S. H. Scudder collected "on the crest of the Roan Mountains near the head of East Salt Creek in Western Colorado, and on the buttes bordering the White River near the Colorado-Utah boundary."[2] Owing to the failure of his health, Scudder was not able to complete the description of the rich materials he obtained, and they have remained untouched to the present day. I am extremely indebted to Dr. R. S. Bassler for the photographs illustrating this paper, as well as for many courtesies.

[1] Winchester, Bull. 641-F, U. S. Geol. Survey, p. 140.

[2] Tertiary Rhynchophorous Coleoptera of the United States, p. 7.

ODONATA.

Family AGRIONIDAE (CALOPTERYGIDAE).

EOCALOPTERYX, new genus.

Only the apical part of wing is preserved, but it nearly agrees with *Agrion* (*Calopteryx*), having the same dark fuscous color and white stigma, small cells, and numerous short veins in the marginal area. It differs in having the stigma well defined, with a strong border, and perfectly regular, except that it is somewhat convex below. Beyond the stigma is a single cell, then five pairs of cells, and last two single cells. In the apical region, about four little veins reach the margin in a distance of 1 mm. In outline, the end of the wing is not nearly so broad and obtuse as in *Agrion*, but has the shape of *Pseudophaea*. The stigma, however, is short, whereas in *Pseudophaea* and other related genera it is very long. It is not often that an extinct genus appears to be the immediate ancestor of a living one; but the present insect may fairly be regarded as ancestral to *Agrion*.

Type.—*Eocalopteryx atavina*, new species

EOCALOPTERYX ATAVINA, new species.

Plate 32, fig. 2.

Breadth of wing, 8 mm., from apex, 8 mm.; stigma, 2.6 mm. long, very oblique, the side on costa 2 mm.; depth of stigma, about 0.7 mm. Although the part of the wing preserved appears superficially dark fuscous all over (except the stigma), the cells (especially in the region below the stigma) have more or less hyaline centers, giving the wing a spotted effect under a lens. This is not true of the modern *Agrion*, but may be observed in *Pseudophaea*.

Type.—U.S.G.S., 888, Green River, Wyoming. (Scudder collection.)

Holotype.—Cat. No. 66549, U.S.N.M.

PROTAMPHIPTERYX, new genus.

Antenodal cross-veins six, of which only the first two (which are heavier than the others) cross the subcostal space; arculus remarkably basad, midway between first and second antenodals; postnodals very numerous, 21 visible in specimen, separating cells which are mostly not much broader than high; postnodals not meeting the cross-veins of the series below; subnodus extremely oblique, in a line with lower part of nodus; M_3 separating from M_{1+2} half way between level of second and third antenodals; M_2 leaving M_1 far beyond nodus, at level of middle of seventh postnodal cell; doubling of cells between M_1 and M_2 beginning at level of twelfth postnodal cell; a short distance beyond level of nodus, M_3 is conspicuously nearer to

M_3 than to M_4, but cells between M_3 and M_4 are not doubled in this region. Other parts of wing unknown.

Type.—*Protamphipteryx basalis*, new species.

PROTAMPHIPTERYX BASALIS, new species.

Plate 32, fig. 3.

Wings hyaline, with dark veins; base of wing to nodus 9 mm.; nodus to twenty-first post nodal, 13 mm.; base to arculus 3 mm.; arculus to origin of M_3 1.7 mm.; nodus to separation of M_2, 3.3 mm.; first antenodal from base of wing 2.5 mm.

Type.—U.S.G.S., 812 and reverse, 755. Green River, Wyoming. (Scudder collection.)

Holotype.—Cat. No. 66550, U.S.N.M.

I hesitated at first, whether to place this in the South American genus *Amphipteryx;* but it may be separated by its remarkably basal arculus; the smaller number of antenodals, with only two continued across the subcostal space; and the much shorter cells between M_3 and M_4 at a level a little beyond the nodus, these cells being in fact higher than wide. It is unfortunate that the stigma is unknown.

Family COENAGRIONIDAE (AGRIONIDAE).

EOPODAGRION, new genus.

Rather small dragon flies related to *Megapodagrion*, but having a very oblique brace vein at the lower basal end of stigma; subnodus almost vertical; subquadrangle not so long and narrow, and the cell below it extending considerably basad of its basal end. Eleven cross nervures in costal region between nodus and stigma; stigma on lower side bounding two cells.

Type.—*Eopodagrion scudderi*, new species.

EOPODAGRION SCUDDERI, new species.

Plate 32, fig. 4.

Wing about 23 mm. long; hyaline, with fuscous nervures, the stigma dilute fuscous. Base to nodus about 8 mm.; stigma to nodus nearly 12 mm.; all the costal cells between stigma and nodus are conspicuously broader than long; antenodal cross nervures not well preserved, but I am confident that there are only two. The following measurements are in microns: Stigma on costa, 1,280; stigma on lower side, 1,200; basal side of stigma, 560; length of fifth costal cell beyond nodus, 1,040; lower side of subquadrangle, 1,330; basal side of subquadrangle, 290; lower apical face of subquadrangle, 175; origin of M_3 basad of subnodus, 1,200. The quadrangle is not preserved.

Type.—U.S.G.S. 1133, on the same piece of reddish rock as the type of *Callospilopteron*, almost touching it.

Green River, Wyoming (Scudder collection).

Holotype.—Cat. No. 66551, U.S.N.M.

This differs from *Podagrion abortivum* Scudder by the shorter stigma, but the difference is similar to that between the anterior and posterior wings of *Megapodagrion*, though rather more pronounced. If Scudder's insect was a hind wing, the present one may possibly represent the anterior wing of the same species. I have given it a different name, since it is not a *Megapodagrion* (*Podagrion*), and the characters principally relied upon for its classification are not visible in Scudder's type. Scudder's insect may stand provisionally as *Eopodagrion* (?) *abortivum*.

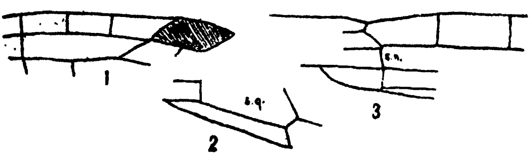


FIG. 1.—EOPODAGRION SCUDDERI. 1. STIGMA AND ADJACENT PARTS. 2. SUBQUADRANGLE (*s.q.*) AND CELL BELOW IT. 3. NODUS (*s.n.*, SUBNODUS).

Tillyard[1] regards my subfamily Dysagrioninae as a synonym of his Megapodagrioninae, but my name has priority, a fact which he apparently does not consider of any consequence. The vertical subnodus seems really to be a primitive character[2] in spite of Mr. Williamson's opinion expressed in 1908.[3]

TRICHOPTERA.

Family LIMNEPHILIDAE.

LIMNEPHILUS (sens. lat.) EOCENICUS, new species.

Plate 32, fig. 5.

Anterior wing, 10 mm. long and 3 broad; pallid, more or less strigose or speckled; apex obtuse, outer margin obliquely descending; the whole form and appearance as in modern *Limnephilus*, but the venation can not be made out. The wing is singularly like that of a moth, but under the microsope it is possible to see groups of hairs, precisely as in *Limnephilus*. The only discrepancy is in the fringe, which appears to have been longer than in *Limnephilus*, and more like that of *Oxyethira*, which has a quite differently shaped wing.

Type.—U.S.G.S. 1242. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66552, U.S.N.M.

It is a singular thing that no true Limnephilidae are found in Baltic amber. The family occurs in the Miocene of Florissant, and

[1] The Biology of Dragon flies, 1917, p. 316.

[2] Idem, p. 55.

[3] Amer. Journ. Sci., vol. 26, p. 73.

as now appears probable in the Colorado Eocene. May we suppose that it first developed in America, and subsequently extended to Europe? It is richly developed in the modern American fauna.

Family HYDROPTILIDAE.

HYDROPTILA (sens. latiss.) PHILEOS, new species.

Plate 32, fig. 6.

Male.—Length, 3.5 mm.; anterior wing, 3.9 mm. long and nearly 1 mm. wide; posterior wing, 3 mm. long and about 0.9 mm. wide; width of abdomen about 1 mm. Antennae far (about 400 μ) apart, about 50 μ thick, much shorter than wings. Dark brown, the wings uniform pale sepia, hairy.

Eocene (Green River) shales, "Cathedral Bluffs south of Little Tommies Draw at point where samples were taken" (Winchester, 17–5.) Colorado.

Holotype.—Cat. No. 66553, U.S.N.M.

At first sight this seems to resemble some small Rhyacophilid, such as *Chimarrha aterrima* Hagen; but the wings, while not excessively narrow, are pointed at end, as in the Hydroptilidae. On the other hand, the end of the abdomen is almost exactly like that of the amber species *Rhyacophila profusa* Ulmer, and is not like that of any living or fossil Hydroptilid known to me. The wings are distinctly more pointed than in *R. profusa*, and except for being less elongated, have nearly the outline of those of *Agraylea spathifera* Ulmer. It is therefore somewhat uncertain whether the insect is really a Rhyacophilid or a Hydroptilid. It very possibly represents an extinct genus, but as the venation can not be seen, it is difficult to define it.

HOMOPTERA.

Family FULGORIDAE.

HAMMAPTERYX (?) LEPIDOIDES, new species.

Plate 32, fig. 7.

Anterior wings about 16 mm. long and 8 broad; costal margin very gently arched, except toward the base, where it rapidly descends; apex very obtuse; outer margin gently convex; costal field dilutely brownish, apical and outer margin fuscous to a depth of about 2 mm., excepting a small hyaline apico-marginal spot; in this field the veins appear colorless on a dark ground; and the dark area (except toward the anal angle) includes the outer series of transverse veins (which are about 1.3 mm. from the margin), which circle around the apical field and appear to become continuous with the subcosta; subcosta at about 7 mm. from base of wing or tegmen running very slightly over 1 mm. from costal margin; veinlets reaching the margin very

numerous, about 30 from the hyaline spot to the very obtuse anal angle, and of these very few are branched. Discal region with a pair of round dark spots, nearly 3 mm. apart, the lower more broad. A third dark spot where the radius breaks up into small veins, about 1.5 mm. from the costo-apical margin.

Green River shales back of house at Smith's Ranch, in the vicinity of Cathedral Bluffs, Colorado (Winchester 17.3, U.S.G.S.).

Holotype.—Cat. No. 66554, U.S.N.M.

This is much larger than *H. reticulata* Scudder, and differs in that the subcosta does not bend upward to the costal margin, but runs along parallel with it, in the manner of the living genus *Scolypopa* Stal. Indeed it is not evident that the insect is to be separated from *Scolypopa;* but as this genus is not a member of the present North American fauna and *Hammapteryx* was based on a very similar insect from the Green River shales of Wyoming, I provisionally place the new species in Scudder's genus. There is also a general resemblance to the living genus *Phromnia* Stal.

The specific name is given because the tegmina look like fish scales. The two inner dark spots evidently correspond with those of *Hilavrita trimaculata* Distant, from Ceylon, but they are rather more basad in the living species.

HAMMAPTERYX (?) CERYNIIFORMIS, new species.

Plate 32, fig. 8.

Anterior wings or tegmina about 12.5 mm. long and 8 broad; closely related to *H. lepidoides,* and evidently congeneric with it, but the markings are different. The spot near the end of the radial field is large and has on its inner side a semicircular hyaline spot, the whole effect being that of an asymmetrical ocellus; about 2 mm. below this spot is a vertical slender dark streak about 2 mm. long; 7 mm. from the apex of the tegmen is a very conspicuous but narrow transverse dark fuscous band, terminating above just below the subcosta.

Type.—U.S.G.S.; Winchester's 17.3, Green River shales back of house at Smith's Ranch, near Cathedral Bluffs, Colorado, Aug. 7, 1917. Collected by D. E. Winchester and H. R. Bennett.

Holotype.—Cat. No. 66555, U.S.N.M.

This insect is surprisingly similar to the living oriental *Cerynia maria* (White), even to the black stripes on the tegmina, though these are not arranged in the same manner. About 16 mm. from the tegmen is a hind wing which appears to belong to the same insect. It differs from that of *Cerynia* in having a large closed discal cell such as Distant figures for *Atracis emersoniana* (Walker) or *Gaja inconspicua* (Kirby); as in the *Gaja,* the apical middle of the cell emits a vein, but the apical face is angular instead of truncate. This hind wing is on the piece of rock containing the reverse of the type.

LITHOPSIS DELICATA, new species.

Plate 33, fig. 1.

Tegmen (the only part preserved), 9 mm. long and 2.80 wide, broadly rounded apically, lower margin faintly concave. Subcosta running parallel with costa, about middle of tegmen 400 μ from it, emitting many very oblique veins; radius running parallel to subcosta, a little nearer to it than the subcosta is to costa, about 3.2 mm. from apex of tegmen, bending obliquely upward to meet the subcosta; at the point where radius meets subcosta a straight vein proceeds to the distal margin; from the middle of the oblique end of radius another straight vein goes to the margin, parallel with the first; and a third (branching near end) continues in a line with stem of radius; below this are nine veins running to margin from the transverse (gradate) line; none of these are branched.

Eocene shales, back of house at Smith's ranch, "shale of Green River formation with thin beds oil-shale interbedded," near Cathedral Bluffs, Colorado. (Winchester and Bennett's 17.3.)

Holotype.—Cat. No. 61556, U.S.N.M.

The tegmen is much narrower than that of *L. fimbriata* Scudder, but agrees nearly with *L. elongata* Scudder from Green River, Wyoming. It differs from *L. elongata* in the broadening of the apical end, which in the Wyoming species is narrower than the basal. The characters of the venation are not well known in *L. elongata*. It is not impossible that the present insect should be referred to *elongata*, but the indications are that it is probably distinct.

Compared with modern genera, it seems to belong to the Issinae or to the Tropiduchinae. It is singularly like the Tropiduchine *Vanua vitiensis* Kirkaldy, as figured by Kirkaldy.

LITHOPSIS SIMILLIMA, new species.

Plate 33, fig. 2.

Tegmina about 9 mm. long and 3.9 wide; middle costal region straight; apex very broad and obtuse; subcosta running 0.5 mm. from costa, terminating about 6 mm. from base; apical part of radius sending many long oblique veins to costa; radius on basal half of wing much nearer to radial sector (subradius) than to subcosta; media branching about 3 mm. from base and on one side (but not on the other) the lower branch soon forks again; cubitus forking 4 mm. from base; anal rather abruptly directed downward at level of cubital fork and ending 4.5 mm. from base.

Type.—U.S.G.S 334. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66557, U.S.N.M.

This may not be distinct from *L. fimbriata* Scudder, from Green River, Wyoming; but the course of the anal (second anal) is not

as in Scudder's figure and the costal margin is evenly curved, instead of being obtusely subangulate at about the end of the basal. third. There is at least a strong probability that the insect is specifically distinct.

DETYOPSIS, new genus.

Fulgoridae with broad maculated tegmina, the shape and structure very nearly as in the oriental genus *Detya* Distant. Oblique veins from subcosta to costa numerous (in the typical species about four in 1 mm. of length); radius (in the typical species) about as far from subcosta as the latter is from costa; radial sector forking considerably before middle of wing; media freely branched, apparently much as in *Detya;* subapical field (as in *Detya*) reticulated by rather numerous cross-veins; veins reaching outer margin simple, in the type species nearly four in 1 mm. From *Varcia* Stal, which occurs in the neotropical region, this differs by the denser venation.

Type.—*Detyopsis scudderi,* new species.

DETYOPSIS SCUDDERI, new species.

Plate 33, fig. 4.

Length of tegmina, 11.7 mm.; width, 5.5 mm.; color pale fuscous, with a broad wavy hyaline band across the middle of the disk, broadest on costa, narrower and more or less G-shaped below, the inner margin edged with darker brown; apical margin with two large hyaline spots, an upper and a lower, with an obscure small third one between. The median band corresponds in position with that of *Scamandra diana* Distant, from the Malay region. There is some resemblance to the much smaller *Aphana rotundipennis* Scudder, but the costa is much less arched than in that species.

Type.—U.S.G.S. 305 and (reverse) 273. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66559, U.S.N.M.

DETYOPSIS PACKARDI, new species.

Plate 33, fig. 3.

Length of tegmina, 10 mm.; width, 4.2 mm.; similar to *D. scudderi,* but tegmina narrower, with the region between costa and subcosta only half as broad; median hyaline band very oblique and equally broad throughout as far as the sutural vein, its upper part bent nearly at a right angle; apical region with three marginal hyaline spots, not very large or conspicuous, one on costa, one on outer margin, and one near the anal angle, these corresponding with the spots in *Detya fusconebulosa* Distant, but the third spot (second on outer margin) of *Detya* is absent.

Type.—U.S.G.S. 1180. Roan Mountain, Colorado (Scudder). Named after Dr. A. S. Packard, who collected many fossil insects in the Green River shales.

Holotype.—Cat. No. 66558, U.S.N.M.

PROTOLIARUS, new genus.

Small Fulgoridae resembling *Oliarus*, but with no distinct thoracic keel and no stigmatic spot. The veins are not spotted, as they are in *Cixius*. The tegmina have a short but evident subcostal nervure, running close to the costa for a short distance; radius soon emitting the media, and immediately afterwards dividing into two main branches, of which the uppermost bends downward near the apex of the tegmen (stigmatic region of *Oliarus*), emitting a series of veins to the margin; media bifurcating before middle of tegmen, its lower division branching more than once again; cubitus running parallel with sutural, and close to it, branching near middle of tegmen; sutural (first anal) as in recent forms; the other anals inclosing a long pointed cell, as is usual in recent forms. The hind wing is only partly preserved, but the part visible is figured.

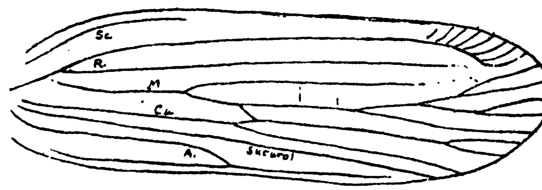


Fig. 2.—Protoliarus humatus. Anterior wing.

Type.—*Protoliarus humatus*, new species.

PROTOLIARUS HUMATUS, new species.

Plate 33, fig. 5.

Length, 5 mm.; tegmina, 5.5 mm. long and 2 mm. wide, extending slightly over 2 mm. beyond abdomen.

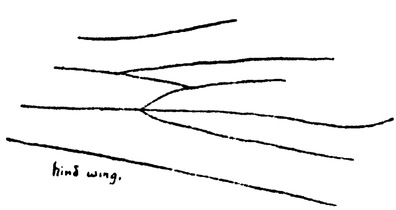


Fig. 3.—Protoliarus humatus. Venation of part of hind wing.

Type.—Green River shales (Eocene), back of house at Smith's Ranch, in the vicinity of Cathedral Bluffs, Colorado. (Winchester 17.3, U.S.G.S.)

Holotype.—Cat. No. 66560, U.S.N.M.

This may possibly be congeneric with Scudder's *Oliarites*, but it seems to be distinct. The characters of *Oliarites* are imperfectly known, and its status as a genus can not be precisely determined.

SCOPARIDEA, new genus.

Tegmina shaped and spotted much as in the Lepidopterous genus *Scoparia*, the costa nearly straight except at base, the apex obtuse, the outer margin oblique; subcosta leaving costa nearly 1 mm. from base, and entering it about 1.3 mm. beyond, thus inclosing a very narrowly lanceolate cell (a condition approached in *Cixius*); radius parallel with costa, but a considerable distance (about 6 mm. in the

type species) from it, its apex depressed and emitting numerous delicate oblique veins to the costal margin (the general effect, as well as the maculation, suggestive of certain Lophopinae); subradius or radial sector running parallel with the radius, and about as far from it as from the media; apical region and outer margin with very numerous parallel delicate veins, about five in 1 mm. measured transversely. There is no regular series of gradate veins, such as occur in *Eofulgorella*.

Type.—*Scoparidea nebulosa*, new species.

SCOPARIDEA NEBULOSA, new species.

Plate 33, fig. 6.

Tegmina 9.3 mm. long, 3.3 mm. broad; maculate in a nebulous or indistinct manner with pale fuscous, tending to alternate light and dark spots between the veins; but the apical 2.5 mm. dark fuscous, inclosing four small hyaline spots arranged in the form of a reversed L, and a subcrescentic oblique hyaline band about 1 mm. long, having its upper end on the costa. The inner margin of the dark area is very irregular, and incloses a large dissected hyaline spot which is only connected with the general pallid field of the wing by a narrow isthmus. There is also a hyaline spot near the anal angle.

Type.—U.S.G.S. 1166. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66561, U.S.N.M.

DILAROPSIS, new genus.

A genus known only from the anterior wing, which has the outline and general appearance of that of some neuropterous insect related to *Dilar*, but the anal region shows it to be a Fulgorid. The costal margin is gently convex, and the subcosta terminates in the margin a little before the beginning of the apical third of the wing. Two branches of the radius run nearly parallel for a considerable distance below the subcosta, but they are only about half as far apart as the first is from the subcosta, and the latter distance is about four-fifths of the distance of the subcosta from the wing margin. Just before the forking of the radius to form the two branches just described, the media diverges at an angle of about 45° and soon emits two branches, the lower continuous with the stem, the upper parallel with the second division of the radius. Numerous veins proceed to the outer margin, without forking near the end.

Type.—*Dilaropsis ornatus*, new species.

DILAROPSIS ORNATUS, new species.

Plate 34, fig. 1.

Anterior wing about 12 mm. long and 5 broad; fuscous, especially the apical third, which is conspicuously darker than the disk. Four

large hyaline spots, about equidistant, on costa; three hyaline spots, successively larger from above down, on outer margin, the first about 1.5 mm. from apex; three broad oblique bands, more or less broken into spots, and not conspicuous (owing to the pallid ground), across the disk of the wing; there is perhaps a fourth band near the base.

Type.—Green River shales back of house of Smith's Ranch, in the vicinity of Cathedral Bluffs, Colorado. (Winchester 17-3, U.S.G.S.)

Holotype.—Cat. No. 66562, U.S.N.M.

Among living Fulgoridae this recalls the species of *Ricania*, but the wings are differently shaped.

CALLOSPILOPTERON, new genus.

Anterior wings broad, with obtuse ends, shaped much as in the Neuropterous *Dilar*, but with a distinct anal angle, and without the subbasal enlargement of costal region; apex obtuse; veins very numerous, not branching as they approach the margin; subcosta ending beyond middle of wing, but before beginning of last third, its apical end bending downward and emitting three very oblique veins, beyond which are seven or eight very oblique veins to the margin, arising from the radius. The genus is noteworthy for the reduced costal region, with consequently very oblique veins leaving the subcosta and radius; also for the relatively short subcosta. The wings carry an ocelliform spot near the outer margin, something like the spots on the hind wings of *Psychopsis*.

Type.—*Callospilopteron ocellatum*, new species.

CALLOSPILOPTERON OCELLATUM, new species.

Plate 33, fig. 7.

Anterior wings 13 mm. long and about 6.4 mm. wide; fuliginous, with a round black or dark fuscous spot, about 1 mm. wide, not far from outer margin; this spot having a pale circle around it, which is enlarged above into a more or less distinct hyaline spot surmounting the dark one. The dark spot is 3 mm. below the costa and about 2.5 mm. from apex of wing. Three simple veins pass from the spot to the margin, and below this are about 13 parallel simple veins running to margin, between the spot and the anal angle. The subcosta ends about 8.7 mm. from base of wing.

Type.—U.S.G.S. 1133. Green River, Wyoming (Scudder collection).

Holotype.—Cat. No. 66563. U.S.N.M. The spot on the wings is strongly suggestive of that on the oriental *Melandeva ocellata* Distant, but it is not in the same place. The venation is very different from that of *Melandeva*.

Family CERCOPIDAE.

CERCOPIS (sens. latiss.) CEPHALINUS, new species.

Plate 34, fig. 2.

Length to tip of tegmina about 12 mm.; tegmina 9 mm. long and about 2.7 mm. broad; head about 3.5 mm. wide, the inner corners of eyes 2 mm. apart; clypeus about 2 mm. long, each side with about 12 transverse ridges, all strong; scutellum about 2 mm. long. Head dark fuscous; tegmina rather pale, with the lower margin and base broadly pale brown; the middle of the costa with a pale brown longitudinal band, followed by a pale spot, after which (beginning 3.2 mm. from apex) is a broad marginal band, about 1 mm. broad, extending to apex. The venation can not be clearly made out, but there is no strong reticulation in the apical field. The preservation of the ventral side of the head is remarkable, showing the ridged clypeus (the two sides separated in the middle), the orbits, the narrow submentum and the broad mentum. Compared with *C. astricta* Scudder, from the Green River shales of Wyoming, this has the tegmina much narrower apically, and also differs in the markings.

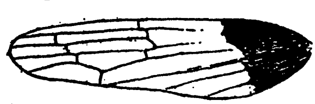


FIG. 4.—CICADELLA SCUDDERI. TEGMEN.

Type.—Eocene shales; back of house at Smith's Ranch, "shale of Green River formation with thin beds oil-shale interbedded." Colorado, Aug. 7, 1917. (S. E. Winchester and H. R. Bennett, 17-3.)

Holotype.—Cat. No. 66564, U.S.N.M.

Family CICADELLIDAE (JASSIDAE authors).

CICADELLA (sens. lat.) SCUDDERI, new species.

Plate 33, fig. 8.

Tegmen about 6 mm. long and 1.5 broad, formed as in *Cicadella;* venation as shown in the figure. About the basal 1.4 mm. is opaque and pure black; the rest is dilute fuscous with dusky veins, the region just beyond the black suffusedly paler.

Type.—U.S.G.S. 113. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66565, U.S.N.M. Very easily recognized by the black basal area.

ERYTHRONEURA EOCENICA, new species.

Plate 33, fig. 9.

Body and tegmina each 4 mm. long, formed as in modern species; head dark fuscous, obtuse anteriorly; eyes further apart than the diameter of one, but somewhat closer than is the usual modern forms; thorax fuscous; scutellum pallid with two large black

spots as in living species; abdomen dilute fuscous, pallid basally; tegmina dusky, with two broad hyaline transverse bands, the first consisting of a large subquadrate patch, separated from an elongate mark below it by a dark line, but the second mark more widely separated from a narrow band along the lower margin. The second band, beginning 2 mm. from base of tegmen, consists of two large elongated patches, separated by a dark bar. There is also an obscure hyaline spot in the costoapical region. The insect is remarkably similar to living species, especially perhaps to the Japanese *E. apicalis* (Matsumura).

Type.—U.S.G.S. 1127. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66566, U.S.N.M.

DIPTERA.

Family TIPULIDAE.

CYLINDROTOMA VETERANA, new species.

Plate 34, fig. 3.

Wing 9.5 mm. long; width nearly 3 mm.; discal cell about 1.9 mm. long, its apex about 2 mm. from apex of wing. Compared with Needham's figure (after van der Wulp),[1] if we make the correction indicated by Brunetti,[2] there is very close agreement. The wing is more slender and more pointed apically than in Needham's figure of *C. distinctissima* Meigen; the subcosta runs closer to the costa, being separated by a very fine linear interval; the lower branch of radius (radial sector) comes off *before* the middle of the wing; the marginal cell is much longer, its length about 3.9 mm., and ends about 1.2 mm. beyond level of end of first basal cell; the uppermost branch of media forks exactly as in *C. distinctissima*, with its upper branch strongly arched at base; the discal cell is longer than in *C. distinctissima*. The anal angle of the wing is subrectangular, more prominent than in *C. distinctissima*, approaching the condition of *Idioplasta*. The apex of the first basal cell is formed as in the Indian *C. quadricellula* Brunetti, not as in *C. distinctissima*, except that the lower apical face (on discal cell) is at least twice as long as the other, which is not at all the case in the Indian species.

Type.—U.S.G.S. 77. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66567, U.S.N.M.

GONOMYIA SCUDDERI, new species.

Plate 34, fig. 4.

Wing about 6.5 mm. long and 2.3 mm. broad, unusually short and broad for a Tipulid; greyish-hyaline, without spots; veins pale

[1] N. Y. State Museum Bulletin 124, pl. 15, fig. 4.

[2] Fauna of British India, Diptera Nematocera, p. 360.

brown. Venation in general as in the Florissant (Miocene) *G. primogenitalis* Scudder, but discal cell much longer. The second basal cell is longer than the first, as in *G. bryanti* Alexander, from Java; but the wing differs from *G. bryanti*, and agrees with the American *G. sulphurella* Osten Sacken, in the base of the submarginal cell. The following measurements are in microns: first basal cell on first marginal, 1550; length of discal cell, 910; second posterior on third posterior, 1040.

Type.—U.S.G.S. 82. Roan Mountain, Colorado (Scudder collection).

Holotype.—Cat. No. 66568, U.S.N.M. A stout-bodied fly, with four black bristles on the scutellum, and the abdomen not bristly, but extremely delicately pilose, is so placed that the above wing looks as if it were attached to it. The actual wings belonging to the body are lost.

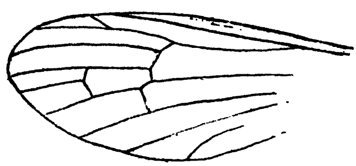


FIG. 5.—GONOMYIA SCUDDERI. WING.

Williston and Needham write *Goniomyia*, but *Gonomyia* is the original spelling.

CYTTAROMYIA FENESTRATA Scudder.

Type.—U.S.G.S. 1095. White River, Colorado (Scudder collection). The wing is 9 mm. long. The original type came from White River, Utah.

Family CULICIDAE.

CULEX WINCHESTERI Cockerell.

Plate 35, fig. 2.

Culex winchesteri COCKERELL, Nature, March 20, 1919, p. 44.

Female, 5.2 mm. long; wing about 4.2 mm.; proboscis 3 mm., distinctly curved; palpi about .4 mm.; thorax about 2 mm. long; abdomen stout, its apex obtuse.

Type.—U.S.G.S., Winchester 17-3. Shales back of house at Smith's Ranch, in the vicinity of Cathedral Bluffs, Colorado.

Holotype.—Cat. No. 66569, U.S.N.M.

Family MYCETOPHILIDAE.

DIOMONUS PALAEOSPILUS, new species.

Plate 34, fig. 5.

Length about 7.85 mm.; length of wing 7.6 mm., the dark spot 3 mm. from base; head small, its width slightly over 1 mm.; thorax large, about 2.65 mm. wide; antennae cylindrical, the joints much longer than wide. Head and thorax dark brown (probably nearly

black in life); abdomen apparently pallid except at base; antennae fuscous; wings hyaline, somewhat dusky, with a large dark spot, and the apical field suffusedly dusky. The venation is shown in the figure.

Type.—Green River (Eocene) shales, Sec. 33, T. 4 S., R. 100 W., Colorado (Winchester 17.6, U. S. Geol. Survey).

Holotype.—Cat. No. 66570, U.S.N.M.

This ancient insect represents a type which has come down to modern times generically unaltered; large size, spotted wings, and all. It is much the largest of the Eocene Mycetophilidae.

PALAEOPLATYURA (?) EOCENICA, new species.

Plate 32, fig. 1.

Female.—Length 5.4 mm.; head small, narrow, its width about 0.6 mm.; antennae with very short joints; abdomen 3.5 mm. long and 1.5 mm. broad; wings 5.1 mm. long and about 1.4 broad, the very obtuse apex extending about 1 mm. beyond end of abdomen. As preserved, the head and abdomen are fuscous, the thorax pale ferruginous, the wings clear hyaline. The radius is thick, and about the middle of the wing is 240 μ from costa. The radial sector leaves the radius at a greater distance from the base than is usual.

FIG. 6.—DIOMONUS PALAEOSPILUS. WING.

Green River shales back of house at Smith's Ranch, in the vicinity of Cathedral Bluffs, Colorado. (Winchester 17.3, U.S.G.S.)

Holotype.—Cat. No. 66548, U.S.N.M.

Family BIBIONIDAE.

PLECIA WINCHESTERI Cockerell

Several specimens from Winchester's locality 17–5 (Cathedral Bluffs, south of Little Tommies Draw, "at point where samples were taken") appear to belong to this species, but the exact details of the venation can not be made out. They are females, with the usual broad abdomen. The length of the insect is from 7.5 to 8.5 mm. The thorax is pallid (probably pale ferruginous in life), and the head and abdomen are dark. Thus the coloration of the body agrees with that of the living *Plecia fulvicollis* Fabricius, and the wings also are about as dark as in that species.

The new locality is about 25 miles from the type locality of *P. winchesteri.*

Family BLEPHAROCERIDAE.

PHILORITES PALLESCENS, new species.

Plate 34, fig. 6.

Length (excluding proboscis) 3 mm.; proboscis stout, directed forward, about 1 mm. long; wings about 3.5 mm. long. Dark fuscous or black, the legs brown; wings dilute brown.

Type.—U.S.G.S., Winchester F. 17–4, spring at head of Little Duck Creek, Colorado; collected by D. E. Winchester and H. R. Bennett.

Holotype.—Cat. No. 66571, U.S.N.M.

This is preserved in exactly the same position as the type of *Philorites johannseni* Cockerell, the position of the wings, one elevated the other depressed, evidently resulting from pressure on the elevated thorax. The details of the venation of *P. pallescens* can not all be made out, but the strong R_1 and R_{4+5} leaving it, are as in *P. johannseni*, and the media is also very distinct. In general, the flies are so similar that they are surely congeneric, but *P. pallescens* is readily distinguished by its smaller size and much paler wings.

On the same piece of rock is an apparent ant, of the size and general appearance of Scudder's *Lasius terreus;* but it has neither wings, legs nor antennae. It is in any event not a *Lasius.*

Oestrid larvae, *Lithohypoderma ascarides* (*Musca ascarides* Scudder) are also found, in great abundance, at Station F 17–4.

Family ASILIDAE.

ASILOPSIS, new genus.

Small flies apparently related to Asilinae or Laphriinae; marginal cell closed far from end of wing; base of marginal obtuse, and the part basad of basal end of first submarginal much longer than that apicad of it; first basal on first submarginal scarcely longer than anterior cross-vein; discal cell elongated, with anterior cross-vein far toward the base; two submarginal cells, the second less than half as long as first; second posterior cell somewhat swollen toward base; fourth posterior apparently open.

Type.—*Asilopsis fusculus*, new species.

ASILOPSIS FUSCULUS, new species.

Plate 35, fig. 3.

Wing (the base not preserved) probably about 9 mm. long; uniform dilute fuscous, except that there is a darker cloud in apical part of marginal cell; the following measurements are in microns: apical petiole of marginal cell, 1760; base of first submarginal to base of marginal, 2480; first basal on first submarginal, 160; discal on first posterior, 1570; first basal on fourth posterior, 1920.

Type.—U.S.G.S., 1076. White River, Colorado. (Scudder collection.)

Holotype.—Cat. No. 66572; U.S.N.M.

This insect is of particular interest, since all the rather numerous Asilidae from Florissant are referable to existing genera. The very long apical petiole of marginal cell, and base of submarginal so near the anterior cross-vein, will at once distinguish it. The dark cloud in the apical part of marginal cell is suggestive of Leptidae, and is not an asilid character. It is possible that if we had the whole fly a distinct family would be indicated, and on the wing alone it seems justifiable to establish a subfamily Asilopsinae.

Family THEREVIDAE.

EOTHEREVA, new genus.

Bare rather elongate flies, similar to *Thereva* in general appearance, but with very long slender antennae, the second joint somewhat longer than the other two together; third longitudinal vein simple, arched, ending slightly above wing-tip, therefore no cubital fork; first longitudinal vein simple and relatively short, as in Therevidae; a very distinct stigmatic infuscation, bounded below by the second longitudinal vein; five posterior cells, the fourth at least contracted, perhaps closed, but indistinct apically; discal cell small and narrow, the anterior cross-vein equally distant from its base and apex; anal cell probably open, perhaps widely so, but its lower side can not be made out.

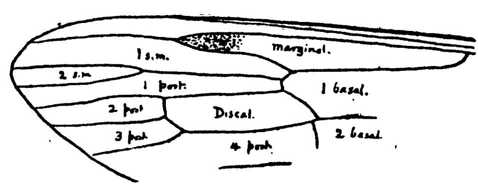


FIG. 7.—ASILOPSIS FUSCULUS. PART OF WING.

Type.—*Eothereva simplex*, new species.

EOTHEREVA SIMPLEX, new species.

Plate 35, fig. 4.

Length 6 mm., of which 3.4 mm. is abdomen; wings about 5.5 mm. reddish hyaline, the stigmatic region darker; antennae about 1.5 mm. long, the first joint 240 μ, the second 880 μ, the third 560 μ. Anterior cross-vein 480 μ from base and apex of discal cell; end of second longitudinal vein to end of third, measured in a straight line, about 1600 μ. Body as preserved pale reddish.

Type.—U.S.G.S. 21, Roan Mountain, Colorado. (Scudder.)

Holotype.—Cat. No. 66573, U.S.N.M.

Certainly a Therevid, but peculiar for the absence of the cubital fork, about which there is no doubt. The long slender antennae are also distinctive.

Family EMPIDIDAE.

PROTOEDALEA, new genus.

A genus of Ocydromiinae; with short antennae, the last joint thick and obpyriform; thorax moderately elevated; abdomen cylindrical; hind legs not spiny or otherwise modified; wings ample, broad basally, much as in *Oedalea*; first radial branch ending far beyond middle of wing (as in *Phyllodromia delicata* Meunier, from Baltic amber), second ending not far beyond it, third ending slightly below tip of wing (a little above in *P. delicata*), and unbranched; discal cell large, narrowly truncate at end, emitting in all three veins, the first apparently incomplete; anal cell not quite so long as second basal, squarely truncate at end, its end making an angle with end of second basal. Differs from *Oedalea* by the simple legs and longer discal cell, but it is closely related. It is also near to *Anthalia*, to which it runs best in Melander's table in Williston's North American Diptera but there is no visible proboscis. It is also near *Euthyneura*, differing in the antennae; Coquillett considered *Anthalia* and *Euthyneura* to be inseparable. In Coquillett's table it appears to run best to *Sciodromia*, but that differs in the proboscis, and has long and narrow wings.

Type.—*Protoedalea brachystoma*, new species.

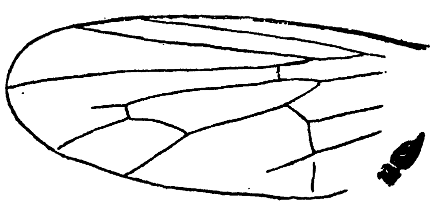


FIG. 8.—PROTOEDALEA BRACHYSTOMA. WING AND ANTENNA.

PROTOEDALEA BRACHYSTOMA, new species.

Plate 35, fig. 5.

Male.—Length, 4.4 mm.; dorsum of thorax convex, but not high; abdomen cylindrical, about 3.6 mm. long; wings 4 mm. long, dusky. Dark fuscous, probably black in life, with venter of abdomen, except apically, pallid. Scanty long hairs on under side of abdomen. No stiff or dark bristles on costa. Proboscis not exserted; eyes apparently contiguous; bases of antennae apparently contiguous. The following measurements are in microns:

Length of hind tibiae, about 1,360; length of hind basitarsi, about 560; width of abdomen about 720; diameter of head about 880; length of discal cell 1,650; discal on second posterior 95; discal on third posterior (not allowing for curve) 480; basal corner of third posterior to apical corner of second basal 960; oblique apical side of second basal 175; apical side of anal 208.

Type.—Green River (Eocene) shales, above rich shale in Camp Gulch, near Roan Creek, Colorado, Sept. 26, 1917 (Winchester 17–8. U.S.G.S.)

Holotype.—Cat. No. 66574, U.S.N.M.

Family SYRPHIDAE.

SYRPHUS LITHAPHIDIS, new species.

Length, about 8.2 mm.; head and thorax 4 mm.; length of wing 6.8 mm. Head and thorax dark fuscous (doubtless black in life); wings hyaline; abdomen pallid with broad dark bands on hind margins of segments, and a broad dark median band, evanescent on the apical half. Venation in general as in modern *Syrphus*, except that the subcostal cell is not nearly so slenderly tapering at the apex, the end of the first vein being somewhat like that figured by Williston[1] for *Paragus tibialis*, though this does not agree well with an actual specimen of *P. tibialis* before me. There is a distinct though not dark cloud filling the apical part of the subcostal cell, as in modern *Syrphus*. The following wing-measurements are in microns: End of auxiliary vein to end of first about 1,600; submarginal cell on first basal about 800; last posterior on second basal about 320; tip of anal to wing margin about 240. The general form and appearance entirely agree with *Syrphus*.

Eocene shales, "Cathedral Bluffs south of Little Tommies Draw at point where samples were taken," Colorado (Winchester 17-5).

Holotype.—Cat. No. 66585, U.S.N.M.

The name is derived from that of the genus of aphides supposed to occur in the Green River shales. In the markings of the abdomen, this closely resembles *S. willistoni* Cockerell, from Florissant.

Family ANTHOMYIIDAE.

ANTHOMYIA (s. lat.) WINCHESTERI, new species.

Plate 35, fig. 6.

Thorax about 3 mm. long, fuscous, with fine hairs and large black dorsal bristles; abdomen about 3 mm. long and 2.7 wide, reddish fuscous, segments 2 to 4 broadly suffused with black basally, except at sides; surface of abdomen with abundant small hairs; segments 2 to 4 with also each a transverse row of black bristles about 560μ long. Legs with fine hairs and bristles, those on tibiae hardly as long as diameter of tibia. The thoracic bristles are not all preserved, but the achrostichal and dorsocentrals were present and very large, the largest about 1,280μ long; there were apparently two large humeral bristles on each side. The abdominal bristles are not preserved on the reverse impression, which shows only fine hairs in the middorsal region; from this alone one might have obtained a quite erroneous impression.

Wings nearly 7 mm. long and 3 wide, dusky, but without spots; costa black, but veins very pale.

[1] N. A. Diptera.

Winchester (U.S.G.S.) 17–8. Green River Eocene. Above rich shale in Camp Gulch, Colorado; Sept. 26, 1917.

Holotype.—Cat. No. 66575, U.S.N.M.

Resembles *A. burgessi* Scudder from Quesnel, British Columbia, but is much larger. It is similar in form to the living *Hyetodesia lucorum* Fallen, with similar long black bristles and short hair on thorax, and similar wings; but it differs by the shorter bristles of abdomen, and the very much shorter leg bristles.

COLEOPTERA.

Family CICINDELIDAE?

Genus CICINDELOPSIS, new genus.

Elytron long and narrow, parallel-sided except at ends; obtuse apically, without any distinct inner apical angle; humeral angle rounded; surface neither punctured nor striate. Color-markings as described under the species.

Type.—*Cicindelopsis eophilus*, new species.

CICINDELOPSIS EOPHILUS, new species.

Plate 35, fig. 7.

Elytron 8 mm. long and 2 mm. wide, with dark markings on a colorless background. The outer margin is narrowly dark, and is separated by a slender pale line from a parallel dark line indicating the epipleura. The large markings are three, as follows. The basal mark, beginning as a broad band at the base of elytron (but not from the humeral region), extends downward, becoming narrower and gently curving outward, to end in a large subcircular patch, the outer edge of which touches the epipleural line; at its lower end this patch extends into a small rounded lobe, and the end of this is 3 mm. from base of elytron. The second mark rises about the middle of the elytron as a subquadrate patch, with one face on inner margin, having attached to its end a large claviform mark directed obliquely downward, its very obtuse end (which is slightly over 5 mm. from base of elytron) not reaching epipleural line; this clavate mark has a small lobe above at its base, and another on its outer face. The third mark is broadly set on the outer margin near the base, and presents a rounded lobe extending downward from its inner apical corner.

Type.—U.S.G.S. 528. White River, Colorado (Scudder collection). In Eocene rock of Green River Age.

Holotype.—Cat. No. 66576, U.S.N.M.

This elytron strongly suggests a Cicindelid, but most (not all) Cicindelids are distinctly punctured, have broader elytra, and have a distinct inner apical angle. The Collyrinae, however, have narrow elytra shaped essentially as in *Cicindelopsis*. The pattern impresses

one as being characteristically Cicindelid, and I can not find anything much like it elsewhere, as for instance among the Cerambycidae, where I sought hopefully for some time. In the form of the basal mark there is even a suggestion of certain Heteromera, as for instance *Dircaea venusta* Champion, from Tasmania; but this apparently has no significance. When we come to compare the existing Cicindelidae, there is nothing very close, but the plan of the pattern is similar. The third mark, on the outer margin, is not characreristic of the Cicindelidae, but may be derived from the condition seen in *Cicindela guttata* Wiedemann. The basal mark is more or less evident in many species. The matter is of more than ordinary interest, because of the total absence of Cicindelidae in the Florissant (Miocene) shales. In Europe, also, Edm. Reitter found no Cicindelidae in Baltic amber (Oligocene); and although W. Horn reported our American *Tetracha carolina* Linnaeus in Baltic amber, it must surely have been a fake specimen, of which many are unfortunately extant. *Cicindelites armissanti* Meunier, from the Oligocene of France, is declared by W. Horn not to be a Cincindelid.

Family CARABIDAE.

CARABITES EOCENICUS, new species.

Plate 36, fig. 1.

Elytra black, 9 mm. long and 3 broad, with eight fine but very distinct striæ, not counting the marginal one; the abbreviated inner basal stria is represented only by a faint groove running parallel with and extremely near to the margin of the rather large scutellum, the sides of which are about 1 mm. long. Striae not punctured, nor are there any surface or submarginal punctures. About the middle of the elytra 1 mm. measured transversely, includes three interspaces. There is a feeble short stria basally between the first and second.

Type.—U.S.G.S. 627. White River, Colorado (Scudder collection). Differs from *Carabites exanimus* Scudder, by having one stria less, and no concavity of the outer margin toward the apex.

Holotype.—*Cat.* No. 66577, U.S.N.M.

Compared with *Pterostichus*, this shows little difference except the absence of the submarginal punctures. In *Pterostichus* the first (innermost) stria is deplaced sideways near the base, and is separated by a ridge from the abbreviated inner basal stria. In the fossil the first stria is continuous in a straight line until it passes into the groove along the scutellar margin, described above. A short stria between the first and second evidently represents the basal end of the first as seen in *Pterostichus;* and the inner basal stria of *Pterostichus* is homologous with the basal end of the first stria in the fossil. I find that in the living *Pterostichus menetriesii* Motschulsky, from Yuma, the first stria is practically continuous with the inner basal,

and the condition is essentially as in the fossil. In *Harpalus*, also, the condition is as in the fossil.

HARPALUS VETERUM, new species.

Plate 36, fig. 2.

Length 8 mm.; elytra 5 mm. long and 2 broad. General form and appearance as in *Harpalus;* the elytra with eight delicate striae, not counting the marginal one; these sharp and not at all punctured. Mandibles stout; eyes 1 mm. apart, rather small for *Harpalus;* thorax short and broad; scutellum rather large, but its apical angle conspicuously less than in *Harpalus erraticus*.

Type.—U.S.G.S. 143. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66578, U.S.N.M.

Family CHRYSOMELIDAE.

LEMA (?) PERVETUSTA, new species.

Plate 36, fig. 3.

Elytron about 6.5 mm. long, 3 wide; of the form usual in the genus, but rather wide; surface as preserved with pustuliform spots due to some secondary deposit, but there is some evidence that there were rows of punctures. Markings consisting of large black areas, covering most of the surface, separated by two narrow transverse colorless bands; there is also a broad humeral dark stripe. The epipleura is colorless below the humeral area, and the dark blotches do not quite extend to the inner margin, which, however, is narrowly edged with dark. The transverse light bands (about 0.5 mm. wide) are not quite alike; the first is abruptly turned upward (basad) at each end, on the inner side being separated from the marginal area by a lobe of the second dark patch. The second stripe is oblique, its lower end outward.[1]

Type.—U.S.G.S. 1299. Roan Mountain, Colorado (Scudder).

Holotype.—Cat. No. 66579, U.S.N.M.

The fundamental pattern of the elytra of the Chrysomelidae is very ancient, and reappears in many of the subfamilies. The persistence of similar tendencies is well shown by the duplication of the same patterns by numerous neotropical species of *Lema* and *Diabrotica;* genera not closely related. The three dark bands or areas may be broken into spots, or may be modified to form longitudinal stripes. The pattern of the present insect, with the three dark bands so enlarged as to give the effect of two light bands on a dark ground, is not common. I believe I have seen it in a neotropical *Lema*, but can not now cite the species; it occurs also in *Cryptocephalus* and *Dermorhytis*.

[1] Since the above was put in type, I have found the reverse (U.S.G.S. 1300), which shows that the elytron was fully 8 mm. long, with three pale bands, and a fourth large dark patch in the apical region.

Lema vetusta Heer, fossil in the Miocene of Oeningen, is said by Heer to be allied to *L. merdigera*. The latter species belongs to *Crioceris*, so the fossil must be called *Crioceris vetusta*. The elytra, as shown in the figure, have neither bands nor spots.

HYMENOPTERA.

Family ICHNEUMONIDAE.

PHYGADEUON (sens. lat.) PETRIFACTELLUS, new species.

Plate 36, fig. 4.

Head and thorax black, their combined length 2 mm.; metathorax gibbous in profile (much more so than in the recent members of the same tribe with which I have been able to compare it); abdomen petiolate, the petiole (two segments) short, hardly 1 mm. long, black; beyond this the abdomen is ovate, about 1.5 mm. long, apparently ferruginous in life, blackened just beyond the petiole (base of third segment); ovipositor very distinctly exserted, but short, about .05 mm. Wings broad and ample, faintly dusky, stigma and nervures ferruginous; aerolet pentagonal, closed; venation as shown in the figure. End of stigma to end of marginal cell 800μ; lower side of third discoidal cell, 720μ.

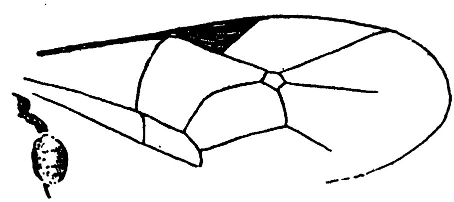


FIG. 9.—PHYGADEUON PETRIFACTELLUS. ABDOMEN AND WING.

Type.—U.S.G.S. 1115 and (reverse) 1117. White River, Colorado. Scudder collection.

Holotype.—Cat. No. 66580, U.S.N.M.

It is impossible to refer this to any of the restricted modern genera, but there are apparently no grounds for the recognition of a new genus. It seems to belong to the Phygadeuonini, but the brevity of the ovipositor is suggestive of Stilpnini.

EOPIMPLA, new genus.

A genus of Pimpline Ichneumonidae, characterized by the relatively large size (the largest of the known Eocene forms), with broadly petiolate abdomen and normal terebra; the venation normal in most respects, apparently without an areolet, the stigma large; the basal nervure bent or angled near upper end, its lower end practically meeting the transverso-medial; *the first brachial cell much produced apically, its apical side extremely oblique, emitting the subdiscoideus almost at the lower* (*apical*) *corner.* The hind wing is imperfectly preserved, but it can be seen that the upper apical angle of the mediellan

cell is relatively large, not strongly acute as in many genera. The really diagnostic characters are italicised. The bend in the basal nervure seems to be a normal feature; if so, it is another useful character.

Type.—*Eopimpla grandis*, new species.

EOPIMPLA GRANDIS, new species.

Plate 36, fig. 7.

Female.—Length about 14.5 mm. (excluding ovipositor); length of thorax about 4.25 mm.; anterior wing from base to end of stigma about 8 mm., probable total length of wing about 12 mm.; length of stigma about 1.8 mm.; lower end of basal nervure to transverse-cubital about 4.5 mm., and lower end of basal to basal corner of marginal cell 3 mm.; width of petiole of abdomen about 1 mm. Head and thorax black; abdomen so far as visible light ferruginous, the base of petiole fuscous; terebra (only partly preserved) dark; antennæ pallid; wings hyaline, with ferruginous nervures and stigma.

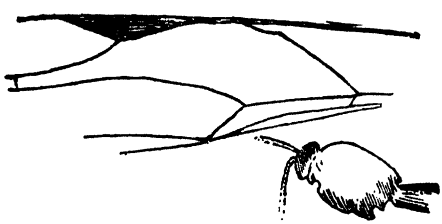


FIG. 10.—EOPIMPLA GRANDIS. PARTS OF BODY AND WING.

Type.—Green River (Eocene) shales, "Cathedral Bluffs South of Little Tommies Draw, at point where samples were taken." (Winchester 17–5, U.S.G.S.) The fly *Dicranomyia primitiva* Scudder (pl. 35, fig. 1) comes from the same place.

Holotype.—Cat. No. 66581 U.S.N.M.

The shape of the end of the first brachial cell is approached in *Ischnocerus*, and the end of the cell with the subdoscoideus recalls the arrangement found in certain ants.

PIMPLA EOCENICA Cockerell.

Plate 36, fig. 8.

Pimpla eocenica COCKERELL, Entomologist, vol. 52, 1919, p. 122.

Head and thorax 3.5 mm. long, abdomen about 4.5 mm.; terebra projecting 1.95 mm. beyond abdomen. Anterior wing 6.5 mm. long; width (depth) of marginal cell 655μ; length of basal nervure 690μ; width (depth) of stigma 400μ; length of areolet 512μ.

U. S. G. S., Winchester's F 174. Spring at head of Little Duck Creek, Colorado.

Holotype.—Cat. No. 66582, U.S.N.M.

Family BRACONIDAE.

EOBRACON, new genus.

Small species with well developed wings; head and thorax ordinary; mandibles not clearly seen, but certainly not as in Alysiidae; antennae

long and slender, the last joint somewhat enlarged, claviform; abdomen shaped as in Cheloninae, without visible sutures, the base sessile but narrow, the apex enlarged, rounded, very obtuse; a long straight ovipositor.

Stigma large; two *inclosed* submarginal cells, the outer side of the second extremely weak; transverse medial nervure not meeting the basal. Second submarginal cell large and quadrate.

Type.—*Eobracon cladurus*, new species.

EOBRACON CLADURUS, new species.

Plate 36, figs. 5, 6.

Length (excluding ovipositor) 4 mm.; abdomen 2 mm.; ovipositor 2.5 mm.; anterior wing 4 mm. long. Head and thorax fuscous (probably black in life); abdomen colorless, with the apex dark fuscous; antennae a little over 3 mm. long, rather more than basal half colorless, the apical part fuscous, the apical joint elongate, swollen. Wings faintly dusky; stigma fuscous; nervures pale brown, second transverso-cubital almost obsolete.

Type.—U.S.G.S. 1106, and reverse 1112. White River, Colorado (Scudder collection).

Holotype.—Cat. No. 66583, U.S.N.M.

The venation is not unlike that of *Diospilus repertus* Brues, from the Miocene of Florissant, but the abdomen is very different. The genus appears to belong to the Cheloninae, but to differ from all those now living.

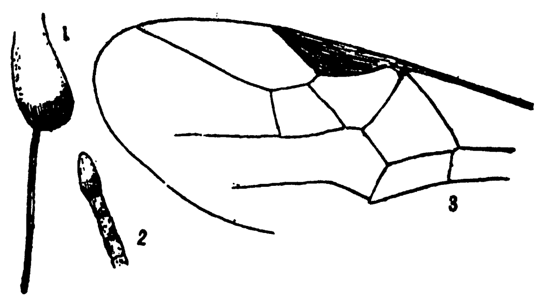


FIG. 11.—EOBRACON CLADURUS. 1. ABDOMEN. 2. END OF ANTENNA. 3. WING.

DESCRIPTION OF PLATES.

PLATE 32.

FIG. 1. *Palaeoplatyura ? eocenica* Cockerell, × 6.
2. *Eocalopteryx atavina* Cockerell, × 3.
3. *Protamphipteryx basalis* Cockerell, × 2.
4. *Eopodagrion scudderi* Cockerell, × 3.
5. *Limnephilus eocenicus* Cockerell, × 4.
6. *Hydroptila phileos* Cockerell, × 6.
7. *Hammapteryx ? lepidoides* Cockerell, × 2.
8. *Hammapteryx ? ceryniiformis* Cockerell, × 4.

PLATE 33.

FIG. 1. *Lithopsis delicata* Cockerell, × 6.
2. *Lithopsis simillima* Cockerell, × 4.
3. *Detyopsis packardi* Cockerell, × 4.
4. *Detyopsis scudderi* Cockerell, ×

FIG. 5. *Protokiarus lunatus* Cockerell, × 6.
6. *Scoparidea nebulosa* Cockerell, × 4.
7. *Callospilopteron ocellatum* Cockerell, × 3.
8. *Cicadella scudderi* Cockerell, × 6.
9. *Erythroneura eocenica* Cockerell, × 6.

PLATE 34.

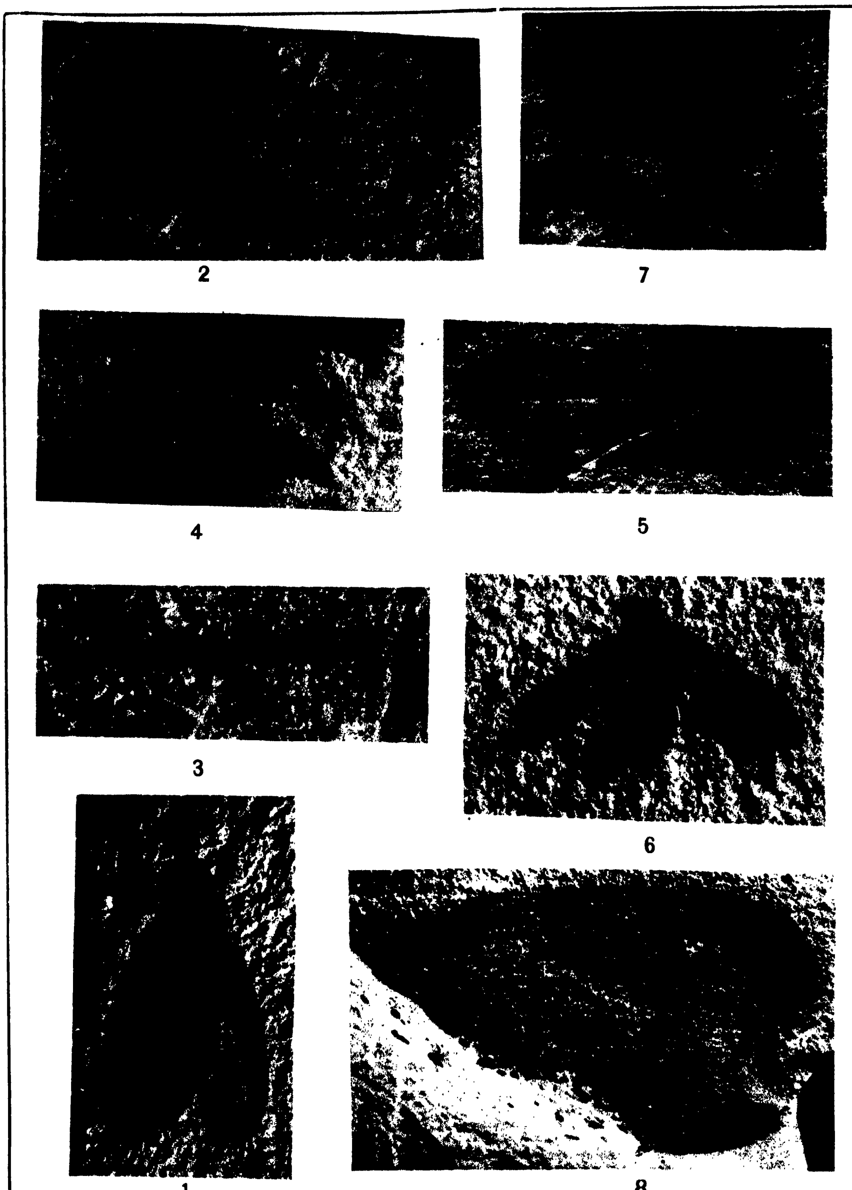
FIG. 1. *Dilaropsis ornatus* Cockerell, × 6.
2. *Cercopis cephalinus* Cockerell, × 4.
3. *Cylindrotoma veterana* Cockerell, × 4.
4. *Gonomyia scudderi* Cockerell, × 4 (wing only).
5. *Diomonus palaeospilus* Cockerell, × 4.
6. *Philorites pallescens* Cockerell, × 4.

PLATE 35.

FIG. 1. *Dicranomyia primitiva* Scudder, × 4.
2. *Culex winchesteri* Cockerell, × 6.
3. *Asilopsis fusculus* Cockerell, × 6.
4. *Eothereva simplex* Cockerell, × 4.
5. *Protoedalea brachystoma* Cockerell, × 6.
6. *Anthomyia winchesteri* Cockerell, × 4.
7. *Cicindelopsis eophilus* Cockerell, × 4.

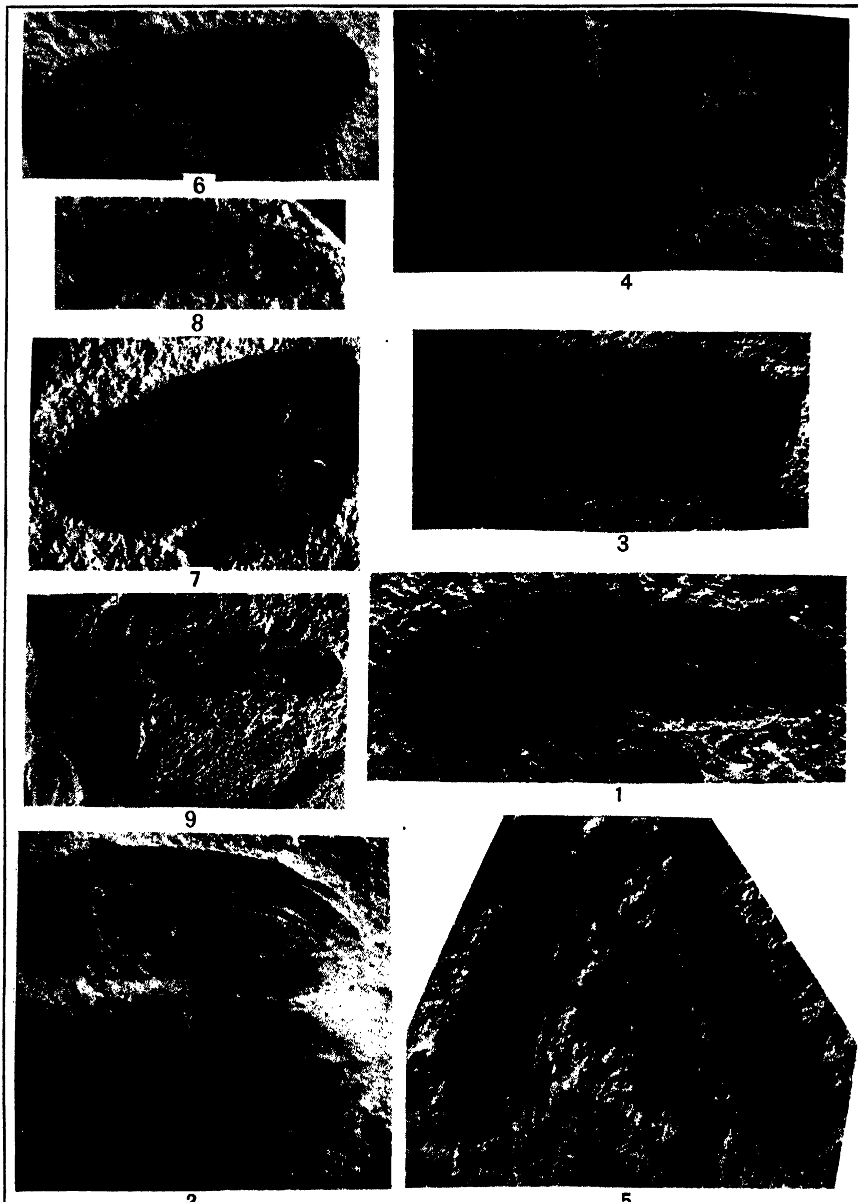
PLATE 36.

FIG. 1. *Carabites eocenicus* Cockerell, x 4.
2. *Harpalus veterum* Cockerell, × 4.
3. *Lema ? pervetusta* Cockerell, × 4.
4. *Phygadeuon petrifactellus* Cockerell, × 6.
5, 6. *Eobracon cladurus* Cockerell, × 4.
7 *Eopimpla grandis* Cockerell, × 4.
8. *Pimpla eocenica* Cockerell, × 4.



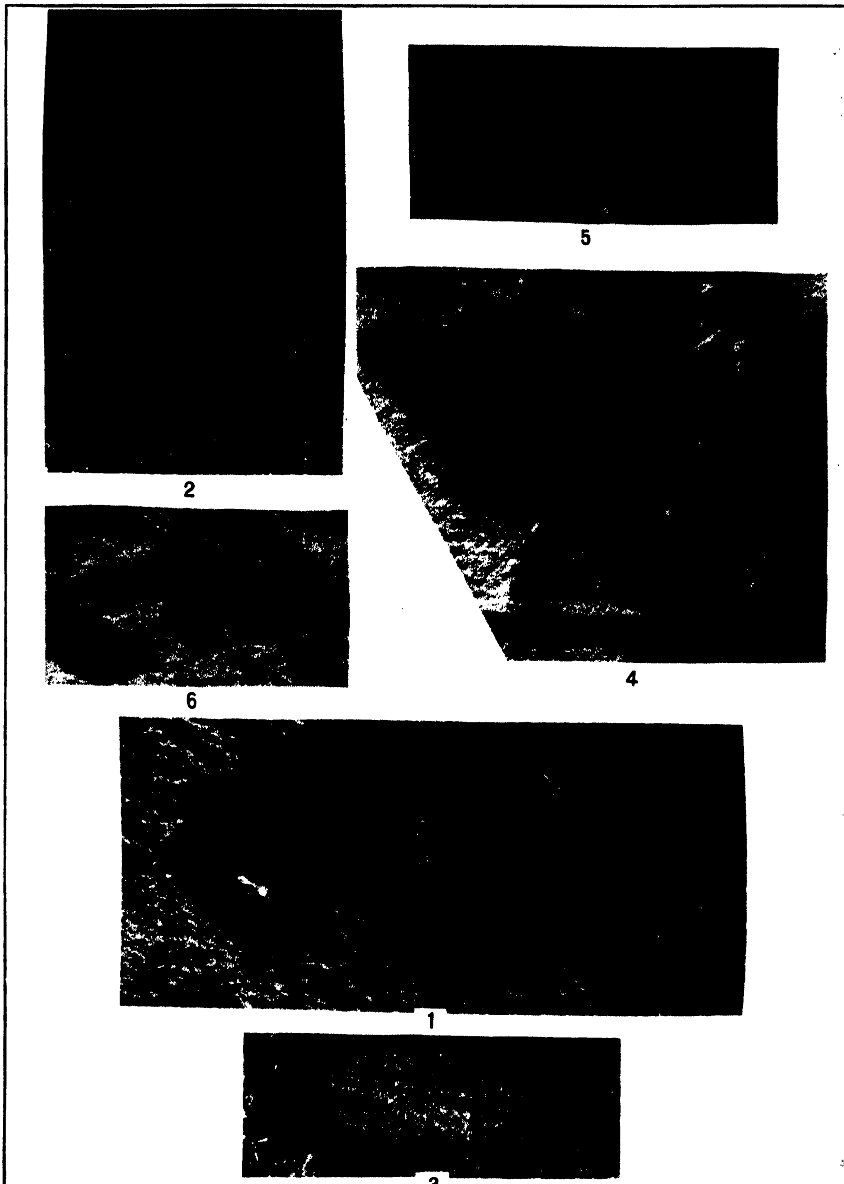
EOCENE INSECTS FROM THE ROCKY MOUNTAINS.

FOR EXPLANATION OF PLATE SEE PAGE 259.



EOCENE INSECTS FROM THE ROCKY MOUNTAINS.

FOR EXPLANATION OF PLATE SEE PAGES 259 AND 260.



EOCENE INSECTS FROM THE ROCKY MOUNTAINS.

FOR EXPLANATION OF PLATE SEE PAGE 260.

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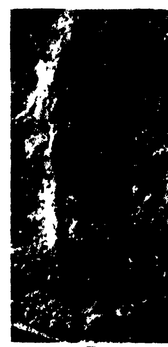
1



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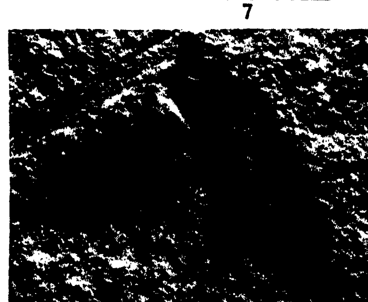

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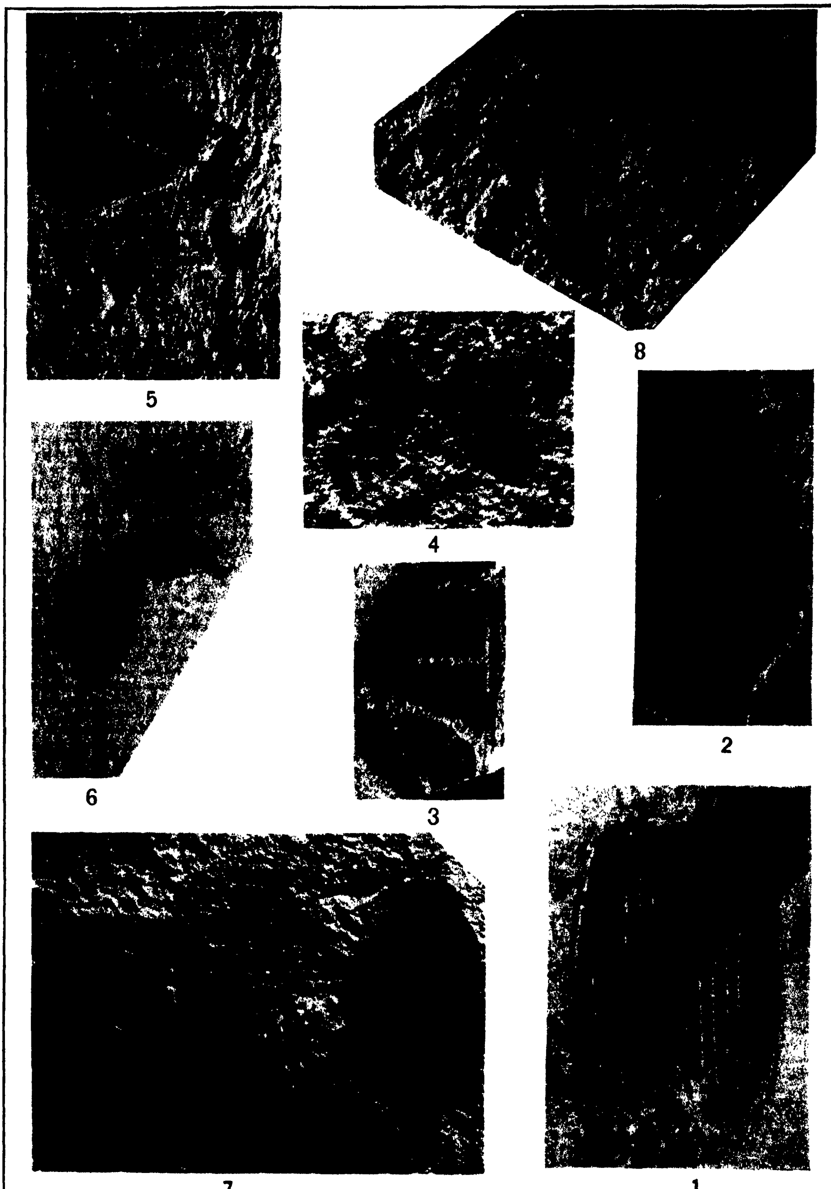
EOCENE INSECTS FROM THE ROCKY MOUNTAINS.

FOR EXPLANATION OF PLATE SEE PAGE 280.



EOCENE INSECTS FROM THE ROCKY MOUNTAINS.

FOR EXPLANATION OF PLATE SEE PAGE 260.

ANNOTATED LIST OF THE RECENT BRACHIOPODA IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM, WITH DESCRIPTIONS OF THIRTY-THREE NEW FORMS.

By William Healey Dall,

Honorary Curator of Mollusks, United States National Museum.

The collection of recent Brachiopods, in the United States Museum began with the material obtained by the United States Exploring Expedition under Wilkes, mostly in the Magellanic region. Since then the chief additions have been received from the dredgings of the steamers of the United States Coast Survey and the United States Fish Commission, now the Bureau of Fisheries; my own dredgings in the North Pacific and Bering Sea; and the material in the Jeffreys Collection purchased by the United States National Museum, chiefly comprising specimens from the North Atlantic and the Mediterranean Sea. Valuable contributions have been received from the West Indies and Florida dredgings of Mr. J. B. Henderson, jr., and from the University of Tokio, collected by Prof. E. S. Morse. Miscellaneous small purchases and exchanges have filled various gaps.

The total reserve series now contains 181 different forms represented by over 6,000 specimens from various localities, including many original types, and of these some 33 are new. Our principal weakness lies in the absence of some recently described forms from the southern hemisphere, and a few of the abyssal rarities.

I have not had the privilege of examining the collection of the late Thomas Davidson now in the paleontological department of the British Museum (Natural History), but with this possible exception the collection in the United States National Museum is, I believe unrivaled.

In the preparation of the list the classification of Beecher and Schuchert has in the main been followed, supplemented by data from later researches.

In reviewing the nomenclature it was found that some changes were necessary, due to the fact that Dr. Thomas Davidson, Mr. J. Gwyn Jeffreys and some others of the earlier writers seem to have been little interested in this branch of the subject, and often included in their synonymy admittedly earlier names than those they habitu, ally used, with no consideration of the claims of priority, as in the case of the two species described by Pallas, of which one was accepted

and the other ignored, though the latter was completely identified. Moreover, in the case of Doctor Davidson's Monograph of the Recent Brachiopoda, his premature death before publication left his synonymy in such a confused condition that it is absolutely essential to verify every reference by an inspection of the original work cited, if accuracy is to be secured.

All this has resulted in changes, some of which will no doubt be much regretted, but which are inevitable if the character of the work here presented is to be kept up to the ordinary standard of accuracy.

In tabulating the specimens the column under "Collector" refers not only to the actual collector but, when he is not known, to the source from which the specimen was received. "B. F." is an abbreviation for the Bureau of Fisheries, formerly the United States Fish Commission. When practicable the depth is also cited, but for most of these cases much more information, such as temperature of the water, character of the bottom, etc., is also on record.

It is hoped to supply figures of the new forms at a later opportunity. Specimens suitable for filling gaps in the collection, or enlarging scanty series, are much desired. Collectors or dealers having such material available are requested to communicate with the United States National Museum.

Class BRACHIOPODA.

Order ATREMATA.

Family LINGULIDAE.

Genus LINGULA Bruguière.

Lingula Bruguière, Encycl. Méth., vol. 1, pl. 250, figs. 1*a*–*c*, 1798.—Lamarck, Prodrome, p. 89, 1799, type *Patella unguis* Linnaeus.

LINGULA UNGUIS Linnaeus.

Patella unguis Linnaeus, Syst. Nat., ed. 10, p. 783, No. 671, 1758. Amboyna.—Gmelin, vol. 1, pt. 6, p. 3710, No. 95, 1792.

Mytilus lingua Solander, Portland Catalogue, p. 77, No. 1718, 1786.—Dillwyn, Descr. Cat. Rec. Shells, vol. 1, p. 322, 1817.

Des lingules Cuvier, Bull. Soc. Philom., vol. 1, p. 111, pl. 7, figs. A, B, C, 1797.

Mytilus camellii Shaw, Nat. Misc., vol. 9, pl. 315, 1798 (lower figures).

Pharetra monoculoides Bolten, Mus., p. 159, No. 46, 1798.

Lingula unguis Lamarck, Prodrome, p. 89, 1799.

Lingula anatina Lamarck, Syst. des An. s. Vert., p. 141, 1801.—Cuvier, Annales du Muséum, vol. 1, pp. 69–80, 1802; Règne Anim., vol. 2, p. 502, 1816.—Lamarck, Anim. s. Vert., vol. 6, pt. 1, p. 258, 1819.—Davidson, Mon. Rec. Brach., pt. 3, p. 206, pl. 29, figs. 1–8, 1888.

? *Lingula chemnitzii* Küster, Conch. Cab., ed. 2, vol. 7, p. 13, pl. 1, figs. 4–6, 1843.

Lingula affinis Hancock, Philos. Trans., vol. 148, pt. 2, 1858.

Lingula hirtula (Gray ms. in) Davidson, Mon. Rec. Brach., vol. 3, p. 206, 1888.

Type locality.—Amboyna, Molucca Islands.

Cat. No.	Locality.	Collector.	Number of specimens.
217312	Northern China, Chihli coast	Sowerby	1
111035	Batalay Island, Philippines	Mearns	2
22634	Manila Bay, Philippines	Mearns	3
76709	Viti Islands	Garrett	3
77998	Viti Islands	Garrett	3
88765	Fiji Islands	Stearns	3

While the specific name of *anatina* has been long in use for this species, there are at least four of earlier date and according to the accepted rules there is no choice except to adopt the earliest one, which is that of Linnaeus.

LINGULA MURPHIANA Reeve.

Lingula murphiana (King Ms.) REEVE, Conch. Icon., pl. 1, fig. 3, Nov., 1859.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 215, pl. 29, fig. 11, 1888.

Lingula anatina HANCOCK, Philos. Trans., vol. 148, pt. 2, 1858; not of Lamarck.

Type locality.—Moreton Bay, Australia. Capt. King.

Cat. No.	Locality.	Collector.	Number of specimens.
162638	Northeast Australia	Stearns	2
77272	Australia	Cuming	2
2250	Fiji Islands	U. S. Ex. Exp	2
17830	Vita Leva, near Rawa River	U. S. Ex. Exp	2
111079	Off Shimbawa Gulf, Japan	E. S. Morse	1

LINGULA ROSTRUM Shaw.

Mytilus rostrum SHAW, Nat. Misc., vol. 9, pl. 315 (upper figures), 1798.

Lingula hians SWAINSON, Philos. Mag. and Journ., vol. 62, p. 401, 1823.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 216, pl. 29, figs. 12, 13, 1888.

? *Lingula antoni* KÜSTER, Conch. Cab., new. ed., *Brachiopoda*, p. 14, pl. 1, figs. 7–9, 1843.

Type locality.—"Amboina."

Cat. No.	Locality.	Collector.	Number of specimens.
17828	Australia	U. S. Ex. Exp	3
153321	Amboyna, Moluccas Islands	Bickmore	1
111037	Amboyna, Moluccas Islands	Bickmore	1

An examination of Shaw's figures leads to the above identification. They can not at any rate represent *L. unguis*.

LINGULA TRANSLUCIDA, new species.

Valves polished, very thin, more or less translucent, of a ruddy brown, darker distally, paler at the umbones, the margins in drying recurved but not gaping anteriorly, ovate with sharply pointed beaks, the peduncle not greatly longer than the valves; length of dry shell 25, breadth 12, diameter about 5 mm.; the setae short.

Type locality.—Java, Ward.

Cat. No.	Locality.	Collector.	Number of specimens.
174003	Java	Ward	2
226219	Java	Palmer	1
150706	Karachi	Captain Shopland	2
332782	Karachi	Fulton	2
236174	Tataan Island, Philippine Islands, 12 fms	B. F	1

The only described species which approaches this is *Lingula hirundo* Reeve, from Northeast Australia. The latter is described as greenish and the outline is figured as more rectangular. I have not seen specimens, but the differences, taken in connection with the geographical distribution, seem to warrant specific distinction.

Type.—No. 332782, U.S.N.M.

LINGULA ADAMSI Dall.

Lingula tumidula A. Adams, Ann. Mag. Nat. Hist., ser. 3, vol. 11, p. 100, 1863.—Davidson, Proc. Zool. Soc., 1871, p. 310, pl. 30, fig. 1, 1871; not of Reeve, 1841.

Lingula adamsi Dall, Proc. Acad. Nat. Sci. Phila., for 1873, p. 202.—Davidson, Mon. Rec. Brach., pt. 3, p. 218, pl. 28, fig. 19, 1888.

Lingula lepidula Dunker, Index Moll. Mar. Japonici, p. 254, 1882; not of A. Adams, 1863, according to Davidson.

Type locality.—Tsaulian Harbor, Korean Archipelago, in 7 fathoms. A. Adams.

Cat. No.	Locality.	Collector.	Number of specimens.
274151	Shimabara, Japan	E. S. Morse	2
274152	Akashi, Japan	E. S. Morse	10
274153	Higabukanseki, Higo, Japan	E. S. Morse	6

The shell is mottled with dark brown, darkest distally, and is notable for a thin grayish periostracum which is dehiscent in drying. The setae are conspicuously long, and the peduncle in dry specimens nearly twice as long as the valves.

LINGULA BANCROFTI Johnston and Hirschfeld.

Lingula bancrofti JOHNSTON and HIRSCHFELD, Proc. Roy. Soc. Queensland, Australia, vol. 31, No. 6, p. 67, pl. 1, figs. 1–4, text figs. 1–7, Aug. 8, 1919.

Type locality.—Burnett Head, Hervey Bay, Australia.

Cat. No.	Locality.	Collector.	Number of specimens.
333009	Hervey Bay..............................	T. L. Bancroft.....	2

Prof. T. Harvey Johnston, of the University of Queensland, Brisbane, Australia, has kindly furnished specimens of this species differing from *L. murphiana* anatomically. One of them is of a light translucent brownish gray color, the other dark green and brown, much resembling externally *L. adamsi* of Japan, but somewhat broader proportionately.

LINGULA EXUSTA Reeve.

Lingula exusta REEVE, Conch. Icon. Mon. Lingula, pl. 2, fig. 9, 1859.—TAPPARONE-CANEFRI, Zool. Viaggio della fregata *Magenta*, 1865–68; Malacologia; Acad. R. Sci. di Torino, ser. 2, vol. 28, 1873.—JOHNSTON and HIRSCHFELD, Proc. Roy. Soc. Queensland, vol. 31, No. 6, p. 63, 1919.

Lingula anatina HEDLEY, Proc. Linn. Soc. New South Wales, vol. 23, 1898, according to Johnston, Proc. Roy. Soc. Queensland. vol. 31, No. 6, p. 63, 1919.

Type locality.—Moreton Bay, Australia; Strange.

Cat. No.	Locality.	Collector.	Number of specimens.
333008	Brammo Bay, Dunk Id., N. Queensland	E. J. Banfield.....	1

A specimen, determined by Prof. Johnston, is pale green, somewhat zoned, recalling Reeve's *L. ovalis* in form. The original description calls for a dark coppery yellow brown, as the name implies, but the color in some of the species of *Lingula* is a variable factor.

LINGULA JASPIDEA A. Adams.

Lingula jaspidea A. ADAMS, Ann. Mag. Nat. Hist., ser. 3, vol. 11, p. 101, 1863.—DALL, Proc. Acad. Nat. Sci. Phila., for 1873, p. 177.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 218, pl. 28, figs. 23, 24*a*, 1888.

?*Lingula dumortieri* DAVIDSON, Proc. Zool. Soc., 1871, p. 310, pl. 30, fig. 3.—DUNKER, Index Moll. Maris Japonici, p. 254, 1882; not of Nyst, Coq. et Pol. fos. de la Belgique, p. 337, 1843.

Type locality.—Mososeki, Japan, in 7 fathoms, mud. A. Adams.

Cat. No.	Locality.	Collector.	Number of specimens.
127043	Japan	Rolle	2
124223	Enoshima, Japan	F. Stearns	4
128261	Japan	Herman	1
332781	Japan	Fulton	3

Valves mostly of a dark reddish brown, sometimes with a slight touch of green distally. The beaks are rather short.

LINGULA LEPIDULA A. Adams.

Lingula lepidula A. ADAMS, Ann. Mag. Nat. Hist., ser. 3, vol. 11, p. 101, 1863.—DAVIDSON, Proc. Zool. Soc., 1871, p. 311, pl. 30, fig. 4; Mon. Rec. Brach., pt. 3, p. 220, pl. 28, fig. 16, 1888.

Type-locality.—Seto Uchi, Akashi, Japan, in 10 fathoms, mud, A. Adams.

Cat. No.	Locality.	Collector.	Number of specimens.
109164	Yedo Bay, Japan	E. S. Morse	6
173632	Japan	Captain St. John	1

This is a small yellowish-white species which looks externally much like *Glottidia albida*, but is less solid, and a true *Lingula*. Doctor Davidson regarded it as possibly the young of a larger species Professor Morse as a distinct form. A much larger series is required to settle all doubt.

LINGULA REEVII Davidson.

Lingula reevii DAVIDSON, *Challenger* Brachiopoda, p. 62, 1880; Mon. Rec. Brach., pt. 3, p. 219, pl. 28, figs. 17, 18*a*, 1888.

Lingula ovalis REEVE, Proc. Zool. Soc., 1841, p. 100; Conch. Icon. Mon. *Lingula*, pl. 1, fig. 1, 1859. Not of J. Sowerby, Min. Conch., pl. 19, fig. 14, 1813.

Type locality.—Hawaiian Islands. Pease.

Cat. No.	Locality.	Collector.	Number of specimens.
17827	Hawaiian Islands	Pease	1

A thin, brilliantly colored, markedly ovate shell.

Genus GLOTTIDIA Dall.

Glottidia DALL, Amer. Journ. Conch., vol. 6, p. 154, 1870.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 221, 1888.

Type.—*Lingula albida* Hinds, 1844.

This genus takes the place in America that is occupied in Asia and Australasia by the genus *Lingula*.

GLOTTIDIA ALBIDA Hinds.

Lingula albida HINDS, Zool. Voy. *Sulphur*, Mollusca, p. 71, pl. 19, fig. 4, 1844.—REEVE, Conch. Icon. Mon. *Lingula*, pl. 1, fig. 4, 1859.

Glottidia albida DALL, Amer. Journ. Conch., vol. 6, p. 157, pl. 8, figs. 1–6, 1870.—DAVIDSON, Mon. Rec. Brach., p. 221, pl. 28, figs. 2–4, 1888.

Type locality.—Magdalena Bay, Lower California, in 7 fathoms sandy mud. Hinds.

Cat. No.	Locality.	Collector.	Number of specimens.
19416	San Diego	Cooper	Figd.
193756	California	Miss Price	2
216713	Off Venice, Calif	Univ. of S. Cal	5
57374	San Pedro, Calif	Mrs. Bush	2
111040	San Pedro, Calif	Dr. Stearns	2
129293	San Pedro, Calif	Miss Shepard	10
111041	San Pedro, Calif	Mrs. Oldroyd	2
253011	San Pedro, Calif	J. White	3
173850	Catalina Island, Calif	Mrs. Trask	1
111039	Catalina Island, 10–15 fms	W. H. Dall	2
56741	San Diego, Calif	Dr. Stearns	2

Hinds's figure represents an adult specimen with only a portion of the original peduncle attached. The valves are nearly always more or less streaked with brown, especially on the sides where a pair of brown streaks are of frequent occurrence. The peduncle varies in length among individuals and is sometimes attached to a small pebble or bit of shell and in many cases entirely free or incased in an irregular sand tube. The most northern locality reported for the species is at Monterey Bay, California. A commensal *Crepidula* (*glottidiarum* Dall) often completely covers each valve.

GLOTTIDIA PALMERI Dall.

Glottidia (*albida* var.?) *palmeri* DALL, Amer. Journ. Conch., vol. 7, p. 77, 1871.

Glottidia palmeri DALL, Proc. Acad. Nat. Sci. Phila., for 1873, p. 204.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 222, pl. 28, figs. 5–6*a*, 1888.

Type locality.—Head of the Gulf of California. Dr. E. Palmer.

Cat. No.	Locality.	Collector.	Number of specimens.
219921	San Pedro, California	Mrs. Oldroyd	23
83227	San Diego, California	Hemphill	3
267499	Concepcion Bay, Lower California	Bartsch	7
111041	Head of Gulf of California	Dr. E. Palmer	2 cotypes.

My doubts as to the specific distinctness of this form from *G. albida* are not entirely removed, although the adults show some marked differences. Dr. Thomas Davidson, however, was of the opinion that they are distinct. He mentions the presence of a very similar species, *G. lesueuri* in the lower Silurian.

GLOTTIDIA AUDEBARTI Broderip.

Lingula audebardi BRODERIP, Trans. Zool. Soc., vol. 1, p. 143, pl. 23, fig. 14, 1835.—G. B. SOWERBY, Thes., vol. 1, p. 338, pl. 67, fig. 5, 1847.—DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 377, 1852.

Lingula audebarti DESHAYES, Anim. s. Vert., vol. 7, p. 390, 1836.

Lingula audebardii KÜSTER, Conch. Cab. Lingula, p. 15, pl. 1, figs. 10–11, 1843.

Type locality.—Isle of Punam, Bay of Guayaquil, in 7 inches hard, sand, between tides. H. Cuming.

Cat. No.	Locality.	Collector.	Number of specimens.
107768	Topolobampo, western Mexico	Capt. J. D. Porter	8

Owing doubtless to the condition in which Doctor Davidson's posthumous papers were left there is an extraordinary confusion in the synonymy of this species in the part of his monograph published after his death. The species is confused with *G. pyramidata* Stimpson, which is not only totally unlike *G. audebarti* specifically, but comes from a different zoological province. The reference under Sowerby should be to the Thesaurus and not to the Conchologia Iconica.

Glottidia audebarti is a large species with the umbonal half mostly white, the distal half of the valves painted with a brilliant blue green, unlike any other species in the genus. The spelling of the original name was corrected by Deshayes to agree with the correct spelling of the name of Baron d'Audebart de Ferussac, whom Broderip desired to honor.

GLOTTIDIA PYRAMIDATA Stimpson.

? *Lingula antillarum* REEVE, Conch. Iconica, Mon. *Lingula*, pl. 2, fig. 8, 1859, Martinique?

Lingula pyramidata STIMPSON, Amer. Journ. Sci. Arts, vol. 39, p. 444, 1860.—W. K. BROOKS, Sci. Res. Chesapeake Zool. Lab., vol. 1, pp. 35–112, pls. 1–6, 1879.

Glottidia pyramidata DALL, Amer. Journ. Conch., vol. 6, p. 158, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 204.—MORSE, Mem. Boston Soc. Nat. Hist., vol. 5. No. 8, pls. 30–32, 43–46, 47, 48, 1902.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 223, (ex parte) pl. 28, figs. 10, 11 (only), 1888.

Type locality.—Beaufort, North Carolina, at extreme low tide, not uncommon. Stimpson.

Cat. No.	Locality.	Collector.	Number of specimens.
32922	North Carolina	Stimpson	10
111038	Fort Macon, North Carolina	Doctor Yarrow	4
133921	North Carolina		3
61804	West Coast Florida	F. B. Meek	10
36036	Cedar Keys, Florida	Hemphill	3
53852	Marco, Florida, l. w. to 3 fms	Hemphill	2
145968	Tampa Bay, Florida	Dall	3
173636	Tampa Bay, Florida	Dall	2

For some time I suspected Reeve's shell to be identical with the North American species, but no subsequent collector has found the shell at Martinique, and none of the numerous specimens of *G. pyramidata* I have seen have the relative width of Reeve's figure or any touch of the green color he reports. I do not find that Cuming himself ever visited Martinique, and am now disposed to think his species was not really American. Cuming's localities, except for specimens of his own collecting, are notoriously unreliable.

Glottidia pyramidata is a small narrow whitish or horny shell, in most cases without calcareous matter enough to dry in normal shape. It has rarely a few brownish specks upon it but never shows any greenish color. Brooks, Morse, and Doctor Beyer have exhaustively described its anatomy and characteristics. As in most cases the southern specimens are larger and more solid than those from northern stations. It is believed to live not much over a year. It was found by Henderson at a depth of nearly two feet in the sand among roots of sea grasses.

Order NEOTREMATA.

Family CRANIIDAE.

Genus CRANIA Retzius.

Crania RETZIUS, Schrift. Berl. Ges. Naturf. freunde, vol. 2, p. 72, 1781, type, *C. craniolaris* Linnaeus, fossil.

Crania DALL, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 27, 1871; Proc. Acad. Nat. Sci. Phila. for 1873, p. 197.

CRANIA ANOMALA Müller.

Patella anomala MÜLLER, Prodr. Zool. Dan., p. 237, 1776.—GMELIN, Syst. Nat., vol. 2, p. 3721, 1792.

Orbicula norvegica LAMARCK, Système, p. 140, 1801.

Crania anomala SOWERBY, Conch. Man., ed. 2, p. 125, fig. 197*a*, 1842.—LOVÈN, Index Moll. Scand., p. 29, 1846.—DALL, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 33, 1871 (full synonymy).—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 183, pl. 27, figs. 1–96, 1888.

Type locality.—Norway. Müller.

Cat. No.	Locality.	Collector.	Number of specimens.
111027	Shetland Islands	Jeffreys	5
14488	Scotland	McAndrew	3
11025	Oban, Scotland	Stimpson	16
334776	Oban, Scotland	Henderson	1
118362	Oban, Scotland	Stimpson	6
14188	Britain	Jeffreys	1
173760	Norway	Jeffreys	2
173761	Dröbach, Norway	Jeffreys	3
173762	Vallö, Norway	G. O. Sars	6
173763	Osterfiord, Norway	G. O. Sars	1
173733	Zetland	Jeffreys	12
173734	Zetland	Barlee	3
173735	Unsthaf, Shetlands	Jeffreys	4
173736	Unsthaf, Shetlands	Jeffreys	3
173737	Unsthaf, Shetlands	Jeffreys	3
173741	Unsthaf, Shetlands	Jeffreys	2
173738	Unsthaf, Shetlands	Jeffreys	13
173739	Shetlands	Jeffreys	1
173740	Shetlands	Jeffreys	10 yo.
173742	Off Lerwick, Shetlands	Jeffreys	9
173731	North of Scotland	*Porcupine* Exp	4
173732	North of Scotland	*Porcupine* Exp	1
173743	Oban, Scotland	Jeffreys	9
173744	Oban, Scotland	Jeffreys	3+
173751	The Minch, Hebrides	Jeffreys	2
173750	Ullapool, Hebrides	Jeffreys	3
173752	Skye	Jeffreys	1 yo.
173747	Loch Fyne, Scotland	Jeffreys	1
173748	Loch Alsh, Scotland	Jeffreys	2
173749	Loch Carron, Scotland	Jeffreys	9
173729	Figured Brit. Conch., vol. II	Jeffreys	1
173730	Figured Brit. Conch., vol. V	Jeffreys	1
173753	West of Ireland, Sta. 6	*Porcupine* Exp	2
173754	West of Ireland, Sta. 7	*Porcupine* Exp	2
173755	West of Ireland, Sta. 2	*Porcupine* Exp	1
173756	West of Ireland, Sta. 12	*Porcupine* Exp	5
173757	Cork Harbor	Jeffreys	4
173758	Larne	Jeffreys	4
173759	Belfast Bay	Jeffreys	6
173764	Cape Breton, France	Jeffreys	1
173765	West of Portugal	*Porcupine* Exp	1
173766	West of Finisterre	*Porcupine* Exp	1
173767	West of Finisterre, Sta. 3	*Porcupine* Exp	1

I follow recent authors in separating the Mediterranean form from that of the North Atlantic, though I have not material enough to enable me to form a decisive opinion of my own.

CRANIA LAMELLOSA Seguenza.

Crania lamellosa SEGUENZA, Pal. Mal. ter. terz. del distr. di Messina, p. 76, pl. 8, fig. 8, 1865.

Crania anomala var. *lamellosa* JEFFREYS, Proc. Zool. Soc., Apr. 1878, p. 414.

Type locality.—Coast of Tunis in 40 to 120 fathoms, for the recent form identified by Jeffreys.

Cat. No.	Locality.	Collector.	Number of specimens.
173778	Coast of Tunis..............................	*Shearwater* Exp....	5 v.

I have not been able to compare the recent specimens in the Jeffreys collection with specimens of the fossil described by Seguenza, and insert this form under the above name entirely on the authority of Doctor Jeffreys. It seems, however, to agree sufficiently well with Seguenza's figures.

CRANIA KERMES Da Costa and Humphrey.

Patella kermes DA COSTA and HUMPHREY, Nat. Hist. of shells, pl. 1, fig. 10, 1770, (according to Davidson).

Crania personata BLAINVILLE, Dict. Sci. Nat., vol. 11, p. 312, pl. 304, fig. 2, 1818.—LAMARCK (ex parte), Anim. s. Vert., vol. 6, p. 238, 1819.—SOWERBY, Thes. Conch., p. 367, 1847.

Orbicula turbinata DESHAYES, Anim. s. Vert., ed. 2, vol. 7, p. 317, 1836.

Crania ringens HOENINGHAUS, Mon. *Crania*, p. 3, fig. 2, 1828.—DESHAYES, Anim. s. Vert., ed. 2, vol. 7, p. 302, 1836.—SOWERBY, Thes. Conch., p. 367, pl. 73, figs. 10–11, 1847.

Crania anomala var. *turbinata* DALL, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 34, 1871.

Crania turbinata DAVIDSON, Mon. Rec. Brach., pt. 3, p. 188, pl. 27, figs. 14–23, pl. 28, figs. 1, 1*a*, 1888.

Type locality.—Sicily, Mediterranean Sea.

Cat. No.	Locality.	Collector.	Number of specimens.
173769	Soloom Bay, Tunis..............................	*Porcupine* Exp.....	30
173768	Sta. 45, coast of Morocco.......................	*Porcupine* Exp.....	2
173773	Off Sicily, 266 fathoms..........................	*Porcupine* Exp.....	5 v.
111026	Corsica..	Jeffreys..............	2 v.
173772	Corsica..	Susini................	2
173771	Toulon...	A. B...................	1
173775	Gulf of Naples......................................	Zool. Sta.............	1
173776	Ægean Sea..	Capt. Nares..........	4
173779	Ægean Sea..	Edw. Forbes.........	1
173774	Bay of Naples......................................	Tiberi.................	2 v.
173770	Adventure Bank....................................	Jeffreys..............	5 v.
202085	Naples..	Dohrn.................	2
131051	Mediterranean......................................	I. Lea.................	1
173781	Mediterranean......................................	Humphreys..........	1
173782	Mediterranean......................................	Issel...................	1

The specific relations between the various Mediterranean Cranias require more thorough investigation.

CRANIA ROSTRATA Hoeninghaus.

Crania rostrata HOENINGHAUS, Mon. Crania, p. 3, plate, figs. 3 *a*–*b*, 1828.

Type locality.—Mediterranean, on corals.

Cat. No.	Locality.	Collector.	Number of specimen.
111028	Mediterranean	T. Davidson	1

Doubtfully distinct from the preceding species.

CRANIA HAWAIIENSIS, new species.

Lower valve pale buff, thin, more or less flexible, the shell substance somewhat radiately fibrous, the margins entire, not crenulated, the inner surface of the disk smooth except for the reproduced irregularities of the substratum, and the slight prominence of the muscular scars; there is no indication of a septum. Breadth 8 mm. length 8 mm. U. S. Nat. Mus. Cat. No. 335294.

Type locality.—Near Bird Island, Hawaiian group, at United States Bureau of Fisheries station 4158, in 20 to 50 fathoms, bottom temperature 78° 6, collected by the United States Steamer *Albatross*, one lower valve adhering to a specimen of *Peristernia crocea* Gray.

No species of *Crania* having been reported from the Hawaiian group, this specimen has a peculiar interest. I should have felt hardly justified in naming it from a single lower valve were it not that it differs from all the described species in its elasticity and fibrous texture and the almost entire absence of calcareous matter. A microscopic scrutiny of a large series of *Xenophora pallidula* in the hope of finding other individuals proved vain. It did reveal a minute specimen of *Discinisca* about two mm. in diameter, with short cirrhi, which, when an attempt to detach it was made, snapped into space and could not be found. This genus is also new to the islands. It came from station 4099, on the north coast of Maui in 152 fathoms, temperature 60° 7.

CRANIA PHILIPPINENSIS, new species.

Shell depressed, attached to a substratum by the whole surface of the lower valve, whitish internally, reddish brown externally, the apex of the upper valve prominent, the posterior margin straight, the general outline rounded-quadrate; upper surface irregularly lamellose, the lamellae not raised, but with small, threadlike, raised, radiating, sparsely distributed lines continuous only on the single lamella; interior of upper valve minutely granulose, with a margin defined by a raised inner ridge, not radiately sculptured, the pedestals of the adductors slightly raised, not coalescent medially, with a small prominence in the middle line just below them; the anterior spaces carry impressions of five or six brachial lobes on each side; the space behind the adductor ridges, with a central diamond-shaped depression the two scars above it not elevated, evenly rounded; interior of

lower valve shallow with a central prominence carrying anteriorly two irregular depressed scars, the posterior scars like those of the upper valve. Mesial diameter of lower valve 14; transverse diameter 19; vertical height of both valves about 5 mm.

Type locality.—Between Masbate and Leyte Islands, Philippines, in 114 fathoms, green mud, at Bureau of Fisheries station 5398.

Cat. No. 274128, Types, seven loose but partly fresh valves probably in part detached from material brought up in the dredge and then living.

The upper surface of this species is unlike that of any of the previously described forms and in other respects it is very distinct from the only other species found in this faunal area. It is much the largest of the tropical species now known.

CRANIA PATAGONICA Dall.

Crania patagonica Dall, Proc. U. S. Nat. Mus., vol. 24, No. 1264, p. 562, Mar., 1902; vol. 26, No. 1342, p. 950, pl. 62, figs. 1, 3; 1903.

Type locality.—West coast of Patagonia in 122 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
96913	Type	B. F.	1 v.
96921	Magellan Straits, 348 fathoms	B. F.	2 v.

The minute short spines with which the surface of the upper valve is covered] distinguish it at once from any other recent species which has been reported up to the present time.

CRANIA POURTALESII Dall.

Crania anomala var. *pourtalesii* Dall, Bull. Mus. Comp. Zool., vol. 3, p. 35, pl. 1, figs. 7*a*–*b*, 1871.

Type locality.—Off the Samboes Reef, Florida Keys, in 116 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
111022	Off the Samboes (type)	Pourtales	1
111024	Off the Samboes	Pourtales	1 v.
61225	Campeche Bank, 200 fms	Doctor Rush	1
111023	Off Cuba in 226 fms	Pourtales	1

Genus CRANISCUS Dall.

Craniscus Dall, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 27, May, 1871, type, *C. tripartita* Münster.—Davidson, Mém. Soc. Linn. de Normandie, vol. 10, pl. 13, fig. 21, 1856.

In this group the mesial septum and the elevated ridges which sustain the adductors in the upper valve are so elevated that they divide the cavity of the valve into three compartments when adult. This characteristic is distinct but less emphatic in the only recent species yet described.

CRANISCUS JAPONICUS A. Adams.

Crania japonica A. ADAMS, Ann. Mag. Nat. Hist., vol. 11, p. 100, 1863.—DAVIDSON, Proc. Zool. Soc. 1871, p. 311, pl. 30, figs. 6, 6*a*; Mon. Rec. Brach., pt. 3, p. 191, pl. 27, figs. 10, 11, 1888.

Type locality.—Gotto Islands, Japan, in 71 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
173780	Gotto Islands, 71 fathoms	A. Adams	1 v.
110831	Kagoshima Gulf, 103 fathoms	B. F.	1 v.
111300	Off Matocot Point, Philippine Islands, 170 fathoms.	B. F	2 v.
297300	Palawan Pass, Philippine Islands, 43 fathoms.	B. F	2 v.
294658	Off Burias, Philippine Islands, 105 fathoms	B. F	15 v.
299597	Sibutu Gulf, Borneo, 162 fathoms	B. F	2 v.
?300352	Gulf of Boni, Celebes, 484 fathoms	B. F	1 v.

The septum in this species is short and, except in fully developed specimens, hardly elevated enough to markedly divide the anterior space. Another peculiarity of this species is that the lower valve is subconical and attached to its substratum only by the central apex instead of by its whole surface as in the typical *Crania*. In one specimen this attached tip shows a central depression, as if there might have been in the very young a peduncular orifice, but as all the specimens were loose valves, dead specimens when dredged, this is doubtful.

Family DISCINIDAE.

Genus DISCINA Lamarck.

Discina LAMARCK, Hist. Anim. s. Vert., vol. 6, p. 236, 1819.—DALL, Bull. Mus. Comp. Zool., vol. 3, pt. 1, p. 39, 1871.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 102, 1888.

Orbicula SOWERBY, Min. Conch., vol. 6, p. 4, pl. 506, 1830. Not of Lamarck, Système, p. 140, 1801.

DISCINA STRIATA Schumacher.

Crania (B) *striata* SCHUMACHER, Essai, p. 102, pl. 20, figs. 1 *a–f*, 1817 (not of Defrance). No locality cited.

Crania radiosa GOULD, Moll. U. S. Expl. Exp., p. 465, figs. 480 *a–c*, 1852.

Orbicula norvegica SOWERBY, Trans. Linn. Soc., vol. 13, p. 468, pl. 26, fig. 2, 1822.

Discina ostreoides LAMARCK, An. s. Vert., vol. 6, p. 237, 1819; not of Turton, Dithyra Britannica, p. 238, 1822.

Orbicula evansii DAVIDSON, Proc. Zool. Soc., 1852, p. 81, pl. 14, figs. 32–34.

Type locality.—Cape Palmas, West Africa. Gould.

Cat. No.	Locality.	Collector.	Number of specimens.
5962	Cape Palmas (types)	U. S. Expl. Exp.	3
173783	West Africa	Sowerby	3

Genus DISCINISCA Dall.

Discinisca DALL, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 37, 1871, type, *D. lamellosa* Broderip.

DISCINISCA LAMELLOSA Broderip.

Orbicula lamellosa BRODERIP, Proc. Zool. Soc., 1833, p. 124; Trans. Zool. Soc., vol. 1, p. 142, pl. 23, fig. 2, 1835.

Discina lamellosa S. P. WOODWARD, Man. Moll., p. 336, figs. 160–162, 1856.

Discinisca lamellosa DALL, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 41, 1871.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 197, pl. 26, figs. 1–8, 1888.

Type locality.—Iquiqui, Bay of Ancon, Peru. Cuming.

Cat. No.	Locality.	Collector.	Number of specimens.
173629	Peru	Flower	1
173630	Peru	Jeffreys	1
110740	Off Peruvian coast 2,845 fathoms (dead)	B. F.	1 v.
17826	Callao, Peru, l. w.	U. S. Expl. Exp.	Many.
131040	Arica, Peru	Chamberlain	10
102026	Callao, Peru	Stearns	4
217568	Peru	S. Smith	2
59568	Valparaiso, Chile	Stearns	2

The Disciniscas are naturally divided into three groups as follows:

A. Large, lamellose, flexible, without radiating sculpture. Examples: *D. lamellosa*, *D. laevis*.

B. Large, less lamellose, with feeble irregular radiations, more solid. Examples: *D. strigata*, *D. cumingi*.

C. Small, with regular radiating sculpture, not lamellose, solid. Examples: *D. stella*, *D. antillarum*.

Groups A and B are confined to the western coasts of the Americas; group C to the east coast of Asia and associated islands and the shores of the tropical Atlantic.

The discrimination of the species, especially if the valves are a little worn, is not always easy, but the outside sculpture of the lower valve and the form of the peduncular orifice afford excellent and easily recognizable characters. They have also the advantage of being less liable to wear and incrustation than the upper valves.

In the case of *D. lamellosa*, there is a very short groove at the center of the valve suggesting a closed central pedicel opening in the very

young; the base is evenly closely concentrically lamellose; the peduncular area is ovate-lanceolate, deeply impressed, with the opening narrow, elongate, close to the posterior margin and usually separated from it by a thin papyraceous narrow band which is in the majority of dry specimens broken away so that the orifice is not entire, but has the aspect of a sulcus. This species lives near low water and is often exposed in large masses at extreme ebb tides.

DISCINISCA LAEVIS Sowerby.

Orbicula laevis SOWERBY, Trans. Linn. Soc., vol. 13, p. 468, pl. 26, figs. 1 *a–d*, 1822.—REEVE, Conch. Icon., *Orbicula*, pl. 1, figs. 4 *a–b*, 1862.

Discinisca laevis DALL, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 42, 1871; Amer. Journ. Conch., vol. 7, p. 76, 1871.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 195, pl. 26, figs. 1, 9, 10, 11; 1888.

Type locality.—Concepcion, Chile, in 6 fathoms. Cuming. The habitat of the original specimen was unknown, but the species was later found as above by Cuming.

Cat. No.	Locality.	Collector.	Number of specimens.
265794	Point Abreojos, Lower California	B. F	3
111032	Point Abreojos, Lower California	Hemphill	10
111029	Ipolito Point, Lower California	Capt. Porter	3
37248	No locality		2 v.
15826	Cape San Lucas, Lower California	Xantus	4 v.
61364	Gulf of California	Mex. Comm	1
264856	Sta. Maria Bay, Gulf of California	B. F	14
122840	Panama	B. F	1
207698	Ancon Bay, Peru	Peruvian Govt	4
17824	Peru	H. Cuming	1 v.

This species has a rather prominent central septum on the inside of the lower valve. The exterior of this valve is well figured by Reeve (fig. 4b), having low arcuate lamellae starting from the peduncular large depressed area and surrounded by a marginal band of concentric lamellae. The foramen is narrow and not so near the margin as that of *D. lamellosa*. Davidson's figure 9 is a poor copy of Reeve; the base shown in figure 11 of Davidson's plate 26, is that of *D. lamellosa* and not *D. laevis*. The posterior extremes of the horny part of the valve meet but do not coalesce behind the peduncular area.

DISCINISCA STRIGATA Broderip.

Orbicula strigata BRODERIP, Trans. Zool. Soc., vol. 1, p. 143, pl. 23, fig. 1, 1833.

Orbicula cumingii REEVE, Conch. Icon., *Orbicula*, fig. 6, 1862; not of Broderip.—DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 276, 1852.

Discinisca strigata DALL, Bull. Mus. Comp. Zool., vol. 3, p. 42, 1871.

Discinisca cumingii DAVIDSON, Mon. Rec. Brach., pt. 3, p. 202, 1888, *ex parte*.

Type locality.—Cana Island, Guatemala, 18 fathoms. Cuming.

Cat. No.	Locality.	Collector.	Number of specimens.
130567	San Pedro, California	I. Shepard	1
129284	San Diego, California	Hemphill	1
111030	Margarita Bay, Lower California	Porter	2
111031	Magdalena Bay, Lower California	Nichols	2 v.
217829	Magdalena Bay, Lower California	Orcutt	8 v.
41588	Mazatlan, Mex	Carpenter	1
15372	Realejo		1
101942	Nicaragua	Stearns	1
3859	Panama		1

This species is quite distinct from *D. cumingi* with which it has generally been confused. The California specimens above cited are probably adventitious, from scrapings of small coasting craft doing business to the southward. When fresh the radial stripes of dark color distinguish it sharply from any other species of the genus, but these gradually fade out in the cabinet. The texture is much more calcareous than that of any other west American species. The surface of the upper valve is quite regularly radiately threaded, especially in the young. The horny part of the lower valve is continuous behind the peduncular area, which is very large, the surface of the valve about it is regularly radiately striated. In old specimens the striation is obsolete or absent on the peripheral part of the upper valve, and the surface is apt to be quite irregular.

DISCINISCA CUMINGII Broderip.

Orbicula cumingii Broderip, Proc. Zool. Soc., 1833, p. 124; Trans. Zool. Soc., vol. 1, p. 143, pl. 23, fig. 1, 1833.

Discinisca cumingii Dall (*strigata* excl.), Bull. Mus. Comp. Zool., vol. 3, p. 42, 1871; Amer. Journ. Conch., vol. 7, p. 76, 1871; Proc. Acad. Nat. Sci. Phila. for 1873, p. 201.—Davidson, Mon. Rec. Brach., pt. 3, p. 202, pl. 26, figs. 23 to 25 (fig. 26 excl.), 1888.

Type locality.—Payta, Peru, in 6 fathoms. Cuming.

Cat. No.	Locality.	Collector.	Number of specimens.
16012	Acapulco, Mexico	Dr. Newberry	1 v.
216281	Panama	J. Zetek	3 v.
17826*a*	Callao, Peru	U. S. Expl. Exp	1 v.
41845	Callao, Peru	U. S. Expl. Exp	1 v.

This is a thinner and more distinctly reticulated species than *D. strigata*, without dark blackish radial stripes, and less calcareous. The basal valve has a large peduncular area, which is figured by Davidson. The sculpture outside of the area is concentrically lamellose with faint radial striae, according to Broderip and Davidson. The Museum specimens are all upper valves.

DISCINISCA ANTILLARUM Orbigny.

Orbicula antillarum ORBIGNY, Moll. Cuba, p. 368, pl. 28, figs. 34-36, 1846.—REEVE, Conch. Icon., *Orbicula*, pl. 1, fig. 2, 1862.

Discinisca antillarum DALL, Bull. Mus. Comp. Zool., vol. 3, p. 42, 1871; Proc. Acad. Nat. Sci. Phila. for 1873, p. 201.—DAVIDSON, Mon. Rec. Brach., pt. 3, 204, pl. 26, fig. 31, 1888.

Type locality.—Cuba, on coral. Orbigny.

Cat. No.	Locality.	Collector.	Number of specimens.
64335	Jamaica	C. B. Adams	3
185369	Nicaragua	W. H. Fluck	3
160694	Goyanna, Brazil	J. C. Branner	1

Peduncular area large, heart shaped, the valve outside of it finely radiately threaded. The upper valve is rather sparsely radiately threaded, generally with a smooth apex and irregular concentric sculpture. The apex is usually rather posterior.

DISCINISCA STELLA Gould.

Discina stella GOULD, Proc. Boston Soc. Nat. Hist., vol. 7, p. 324, 1860; Otia Conch., p. 120, 1865.

Orbicula stella REEVE, Conch. Icon. *Orbicula*, pl. 1, fig. 1, 1862.

Discinisca stella DALL, Bull. Mus. Comp. Zool., vol. 3, p. 41, 1871; Proc. Acad. Nat. Sci. Phila. for 1873, p. 202.—DAVIDSON (*ex parte*), Mon. Rec. Brach., pt. 3, p. 204, pl. 26, figs. 27, 27*a*, 30, 1888.

Type locality.—China Seas, Hongkong. Stimpson.

Cat. No.	Locality.	Collector.	Number of specimens.
1759	Hongkong (type)	W. Stimpson	3
175724	Fukura, Awaji, Japan	Hirasé	3 v.
175611	Hirado, Hizen, Japan	Hirasé	4 v.
228121	Nagasaki, Japan	Univ. Tokio	1 v.
228123	Gulf of Tokio, Japan	Univ. Tokio	1
227260	Yenoshima, Japan	Univ. Tokio	2
217319	Pai-tai-ho, N. China	A. Sowerby	1 v.

Davidson has confused this species with the next. *D. stella* has much the same sculpture as *D. antillarum,* but coarser and tending to papillosity at the intersections of the radial and the concentric sculpture on the upper valve, which has a subcentral apex. The peduncular area is large, heart shaped, and the surface of the valve outside of it finely sharply closely radially threaded. The setae are short, seldom more than just visible outside the shell in dry specimens.

DISCINISCA SPARSELINEATA, new species.

Discinisca stella DAVIDSON (*ex parte*) Mon. Rec. Brach., pt. 3, p. 204, pl. 26, figs. 28, 28*a*, 1888.

Upper valve irregular, nearly without radial sculpture; pale yellow; lower valve with very large heart-shaped peduncular area with sparse, widely separated, fine radial threads outside of it. Setae very long, especially in front, nearly as long as the shell; apex of the upper valve at the posterior third in normal specimens, which have the posterior edge nearly straight. Diameter up to 9 mm., height 3 mm.

Type.—Cat. No. 274131, U.S.N.M.

Cat. No.	Locality.	Collector.	Number of specimens.
274129	Hakodate, Japan	W. Stimpson	1
274130	Fukura, Awaji, Japan	Hirasé	2 v.
274131	Gulf of Tokio, Japan (type)	Univ. Tokio	1

DISCINISCA INDICA, new species.

Shell of variable color, generally pale straw color, the surface of the upper valve with fine radial threads delicately reticulated by concentric elevated lines; the setae very short, lower valve with large rounded peduncular area, the valve around it with sparse arcuate radial threads; the apex subcentral, the initial portion smooth. Normal form rounded, about 11 mm. in diameter and 3 mm. high.

Cat. No.	Locality.	Collector.	Number of specimens.
90305	Bombay (types)	Wesleyan Univ	10
89897	Ceylon	Stearns Coll	2 v.

This species is not unlike *D. sparselineata*, but with feebler and finer sculpture and short setae. In some of the specimens fine concentric striae cut the distal portions of the basal radii. The following specimens from the Philippines may belong to *D. indica*, but only upper valves are available, so their relations must remain doubtful:

Cat. No.	Locality.	Collector.	Number of specimens.
240075	Philippines	Bureau Fisheries	2 v.
229157 [illegible]	North of Corregidor Island, Manila Bay, 37 fathoms	Bureau Fisheries	3 v.
229747	North of Corregidor Island, 28 fathoms	Bureau Fisheries	1 v.
229953	South of Verde Island, 180 fathoms	Bureau Fisheries	1 v.

Genus PELAGODISCUS Dall.

Pelagodiscus DALL, Bull. Mus. Comp. Zool., vol. 43, No. 6, p. 440, 1908.—ALLAN THOMSON, Australasian Antarctic Exp., *Brachiopoda*, pp. 38, 40, 50, 1918.

Type.—Discina atlantica King. Abyssal.

This form has the peduncular area relatively large and the lower valve outside of it smooth as well as the upper valve. The setae are remarkably long and minutely prickly.

PELAGODISCUS ATLANTICUS King.

Discina atlantica KING, Proc. Nat. Hist. Soc. Dublin, vol. 5, pp. 170–73, 1868.—JEFFREYS, Ann. Mag. Nat. Hist., ser. 4, vol. 18, p. 252, 1876; *Challenger* Brach., p. 62, 1880.

? *Discinisca atlantica* DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 261.—DAVIDSON, Mon. Rec. Brach., pt. 3, p. 200, pl. 26, figs. 18–22, 1888.

Pelagodiscus atlanticus DALL, Bull. Mus. Comp. Zool., pt. 43, No. 6, p. 440, 1908.—ALLAN THOMSON, Australasian Antarctic Exp., *Brachiopoda*, pp. 38, 40, 50, 1918.

Type locality.—North Atlantic Ocean in 1,366 fathoms at station 19*a*, *Porcupine* Expedition of 1869.

Cat. No.	Locality.	Collector.	Number of specimens.
111033	North Atlantic, 2,100 fathoms	Jeffreys	1
183620	North Atlantic	J. Murray	1
173621	Station 12, *Valorous* Exp	Jeffreys	6
173622	Station 13, *Valorous* Exp	Jeffreys	1
173628	Station 17, *Valorous* Exp	Jeffreys	1
130339	Off the Azores, 2,995 fathoms	Talisman	1
52164	Southeast of Georges Bank, 1,356 fathoms	B. F.	1
52165	Southeast of Georges Bank, 1,679 fathoms	B. F.	2
52166	East of Georges Bank, 1,710 fathoms	B. F.	1 v.
38429	Off Nantucket shoals, 1,467 fathoms	B. F.	2
78720	Southwest of Nantucket shoals, 1,825 fathoms.	B. F.	2
111034	Off Marthas Vineyard, 1,853 fathoms	B. F.	1
35170	Off Marthas Vineyard, 1,451 fathoms	B. F.	7
44969	Off Marthas Vineyard, 1,525 fathoms	B. F	4
46147	Off Marthas Vineyard, 1,582 fathoms	B. F.	2
78722	Off Maryland, 1,631 fathoms	B. F.	1
108214	Off Fernandina, Florida, 294 fathoms	B. F.	2

This has also been obtained off the Galapagos Islands and off Valparaiso, Chile, in the Pacific, and is the most cosmopolitan brachiopod known.

Order PROTREMATA.

Family THECIDIIDAE.

Genus THECIDEA Defrance.

Thecidea DEFRANCE, in Ferussac, Tableau Syst., p. XXXVIII, 1822 (nude name).—BRONGNIART, in Cuvier, Ossem. foss., ed. 2, vol. 2, pt. 2, p. 325, 1822.—BLAINVILLE, Man., vol. 1, p. 513, 1825.—DESHAYES, Dict. Class. d'hist. Nat., vol. 16, p. 215, Oct., 1830.

Thecidium SOWERBY, Gen. Shells, fasc. 20, Nov. 1823.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 156, 1887.

Thecidea RISSO. Hist. Nat. Eur. Mér., vol. 4, p. 593, 1826.—DEFRANCE, Dict. Sci. Nat., vol. 53, p. 434, 1828.

Type.—*T. radians* Defrance, Cretaceous, Maëstricht.

The synonymy of this genus has been left in a confused state by authors and the tracing of citations to their source has revealed a number of errors which have been extensively copied. Fischer states in his Manuel, (page 1330), "Le genre *Thecidea* crée nominalement par Defrance en Ferussac, 1819, n'a été caractérisé qu'en 1822 dans le dictionnaire classique d'histoire naturelle; le même année, Brongniart cite comme type le *Thecidea radians*." This is not quite exact. The true history of the name is as follows:

Thecidea occurs as a nude name in Ferussac's Tableau. Brongniart in his description of the chalk of the hill of Maëstricht (taken chiefly from the work of Faujas de Saint Fond on that locality, published in 1799) cites four fossils of which the second and third are *Thecidea radians* and *hieroglyphica* of Defrance. There is no reference to either in the text, but after the first name is a reference to Faujas' figure 8 of his plate 17. This of course in conformity with modern usage fixed the genus and the type. Probably in ignorance of this citation, Ferussac in the Dictionnaire Classique in 1822, referred to the genus, under the article Brachiopodes, only by its vernacular name and as "non encore décrit" (p. 47). In this publication it is only in 1830, that Deshayes latinizes the name and diagnoses the genus. Also Sowerby in 1823, while at Doctor Goodall's recommendation correcting the unpublished name to *Thecidium*, states that he does not name the figured recent species because he "will not interfere with Defrance's unpublished account of the genus."

Thus it is clear that the name of Defrance circulated among his colleagues and correspondents several years before it was formally described and it is only by the accident of the citation of Faujas' figure by Brongniart, that the name is preserved in its original form.

The *Thecidea radians* Defrance, according to Bronn is a synonym of *Terebratulites papillatus* Schlotheim, 1813, and was later the *T. pumila* of Lamarck but not of Sowerby. The type of the genus therefore is *Thecidea papillata* (Schlotheim) from the Cretaceous of Maëstricht.

The recent forms differ sufficiently from the fossil type to have been separated as follows by Munier Chalmas.

Subgenus LACAZELLA Munier Chalmas.

Lacazella MUNIER CHALMAS, Bull. Société Géologique de France, ser. 3, vol. 8, 1880, vol. 1, p. 279, Feb., 1880 (?=*Thecidium* Sowerby, 1823).

LACAZELLA MEDITERRANEA Risso.

Thecidium (sp. not named) SOWERBY, Genera of Sh., fasc. 20, fig. 6, Nov., 1823.
Thecidea mediterranea RISSO, Hist. Nat. Eur. Mérid., vol. 4, p. 394, fig. 183, 1826.—DEFRANCE, Dict. Sci. Nat., vol. 53, p. 434, 1828.
Thecidea spondylea SCACCHI, Cat. Conch., p. 8, pl. 1, figs. 7-9, 1836.
Thecidium mediterraneum DAVIDSON, Mon. Rec. Brach., pt. 2, p. 156, pl. 23, figs. 12-22, 1887.

Type locality.—Mediterranean, near Nice.

Cat. No.	Locality.	Collector.	Number of specimens.
173595	Mediterranean	McAndrew	3
11888	Mediterranean	Damon	1
110967	Mediterranean	Dall	1
274154	Mediterranean	Webb	3
173597	Coast of Tunis	Capt. Nares	3
173598	Bay of Naples	Stephanis	2
173599	Bay of Naples	Issel	4
173600	Bay of Naples	Acton	2
17818	Sicily	Alder	1
173594	Port Vendres	Peuchinat	15
173596	Adventure Bank, 40–20 fathoms	Carpenter	1

A careful comparison of all the specimens available has enabled me to add something to Davidson's description of the interior of this species.

The cavity of the beak in the attached valve in fully-developed specimens shows a median septum supporting on each side an excavated plate which anteriorly projects more or less beyond the septum in a prong or point. In some specimens the septum only appears deep in the valve; in others it is prominent at the commissure between the plates and rises between them as a keel. In the fullest development of the arrangement the septum rises to the upper vault of the beak, thus dividing the cavity, in combination with the plates ("coques" of Lacaze Duthiers), into four compartments. The space between the forward prolongation of the plates is not deep, but triangular, and in none of the specimens which I have examined have I seen anything resembling the squarish or bilobed plate figured by Davidson (pl. 23, fig. 14 and fig. 15*b*). I presume in these cases the prongs have been broken off. One of the characters used by Allan Thomson to separate his *Thecidellina* from *Lacazella* is the presence of prongs in the former, but, as above stated, the prongs are quite evident in any well-preserved specimen of the type of *Lacazella mediterranea.*

LACAZELLA MAURITIANA, new species.

This species has a remarkable resemblance to the preceding, with which it has been confounded, but differs by having in the apical cavity of the attached valve instead of a platform supported by a septum, only two long, slender, excavated, upturned processes completely isolated medially, with no sign of a septum. The outer surface is minutely regularly granular. In other respects it agrees closely with *L. mediterranea.*

Cat. No.	Locality.	Collector.	Number of specimens.
173593	Mauritius	Sir H. Barkly	1

Type.—Cat. No. 173593, U.S.N.M.

Subgenus THECIDELLINA J. Allan Thomson.

Thecidellina J. ALLAN THOMSON, Geol. Mag., n. s., dec. 6, vol. 2, No. 616, p. 462, 1915. *T. barretti* Davidson.

This differs chiefly from *Lacazella* by its more simple arrangement of the brachia and their supports.

THECIDELLINA BARRETTI Davidson.

Thecidium barretti DAVIDSON, Geol. Mag., 1864, vol. 1, p. 17, pl. 2, figs. 1, 2, 3.—CROSSE, Journ. de Conchyl., vol. 14, 1866, p. 272.

Type locality.—Jamaica, West Indies.

Cat. No.	Locality.	Collector.	Number of specimens.
64235	Off Montserrat, 86 fathoms	*Blake* Exp	3
64236	Off the Grenadines, 163 fathoms	*Blake* Exp	1
336900	Off Cuba, 100–150 fathoms	Henderson	14

THECIDELLINA MAXILLA Hedley.

Thecidea maxilla HEDLEY, Mem. Austr. Museum, vol. 3, pt. 8, p. 508, fig. 37, July, 1899.

Type locality.—Funafuti atoll, Ellice Islands, in 40 to 80 fathoms on corals. Charles Hedley.

Cat. No.	Locality.	Collector.	Number of specimens.
162264	Funafuti	Hedley	3

THECIDELLINA BLOCHMANNI, new species.

Shell ovate, white, solid, rudely concentrically sculptured externally, the lower valve attached by the apex, the area of the beak flat, with no indication of a pseudodeltidium; the interior finely granulose; the apex being broken off, the characters of the cavity of the beak are unknown, but in what is left there is no indication of a septum; the upper valve is rounded, its inner margin conspicuously granulose; the septum is strong, straight, grooved above, its posterior end tubular, opposite two small holes in the "bridge" lamella; anteriorly the edges of the septum round evenly into the sharp ridge which surrounds the brachial furrows in a nearly circular uninterrupted keel with serrate edge; the kidney-shaped area on each side of the septum is separated from it by a shallow groove; the area thus enclosed has in each case a deep pit posteriorly, and anteriorly is filled with irregularly disposed prominent unequal rounded pustules; the cardi-

nal process is squarish, with an internal medial keel where the septum is prolonged, and above it, in the "bridge", the two rounded holes before referred to. Length of lower valve about 6.5 mm.; transverse diameter 4.25 mm.; vertical diameter about 3.0 mm. Cat. No. 227822, U.S.N.M.

Type locality.—Christmas Island, collected by Mr. Anderson and forwarded to the Museum by Professor Blochmann of Tubingen, Germany. One specimen.

This is nearest to *T. maxilla* but is much more regular, the internal arrangements symmetrical, bilaterally identical, and elegant.

Order TELOTREMATA.

Family RHYNCHONELLIDAE.

Genus HEMITHYRIS Orbigny.

Hemithiris ORBIGNY, Pal. Franc. Ter. Crét., vol. 4, p. 342, 1847.

Hemithyris DALL, Amer. Journ. Conch., vol. 7, p. 70, 1871; Proc. Acad. Nat. Sci. Phila. for 1875, p. 196.

Rhynchonella DAVIDSON, Mon. Rec. Brach., pt. 2, p. 163, 1887.

Type.—*Anomia psittacea* Gmelin.

HEMITHYRIS PSITTACEA Gmelin.

Anomia psittacea GMELIN, Syst. Nat., vol. 2, p. 3348, 1792.

Hemithiris psittacea ORBIGNY, Pal. Franc. Ter. Crét., vol. 4, p. 342, 1847.

Hypothyris psittacea FORBES and HANLEY, Brit. Moll., vol. 2, p. 346, pl. 57, figs. 1-3, 1853.—KING, Ann. Nat. Hist., vol. 18, p. 238.

Rhynchonella psittacea REEVE, Conch. Icon., *Rhynchonella*, pl. 1, figs. 2 *a–c*, 1861.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 163, 1887.

Type locality.—Mari Groenlandiae; Gmelin.

Cat. No.	Locality.	Collector.	Number of specimens.
	ATLANTIC HEMISPHERE.		
173692	Figured specimen. Jeffreys Brit. Conch., vol. 5, pl. 99, fig. 4.	....	......
173693	Figured specimen. Jeffreys Brit. Conch., vol. 5, pl. 8, fig. 2.	....	......
173708	Arctic Sea	Belcher	7
173710	Greenland, station 4	*Valorous* Exp	6
173712	Greenland, station 5	*Valorous* Exp	10
173713	Greenland, Franklin Pierce Bay	*Valorous* Exp	1
173714	Greenland, Holsteinborg	*Valorous* Exp	3
173726	Greenland, Holsteinborg	*Valorous* Exp	20
173717	Greenland, Holsteinborg	Copenhagen Mus	2
181190	Greenland, Ungsuak	McLain	1
111013	Greenland, Upernavik, 13 fathoms	McLain	1
224514	Greenland, Upernavik	McLain	1
111014	Greenland	McLain	2
181263	Greenland, off Hare Id., 90 fathoms	McLain	7
75347	Greenland	Mörch	1

Cat. No.	Locality.	Collector.	Number of specimens.
21910	Greenland	Mörch	1
173704	Spitsbergen, Loom Bay	Eaton	4
173705	Spitsbergen	Torell	1
226059	Franz Josef Land	Ziegler	1
152571	Murman coast	Hertzenstein	3
173706	Norway, Finmark	Sars	2
173707	Norway, Bergen	Koren	1
13978	Norway	Sars	7 v.
173709	Norway (deformed)	Sars	3
173694	Shetlands, Unsthaf	Jeffreys	1
173695	Shetlands (young)	Jeffreys	1
173697	Hebrides	Jeffreys	1
131049	Orkneys	Mrs. Corrie	1
173699	Northumberland coast	Jeffreys	1
173721	"Australia" (?)	Flower	1
34387	Labrador, 8 fathoms	W. A. Stearns	3
173718	Labrador, Hopedale	Packard	3
34388	Labrador, Henley Harbor	W. A. Stearns	2
173719	Gulf of St. Lawrence	Whiteaves	2
50611	Off Newfoundland, 89 fathoms	B. F.	1 v.
111015	Gulf of St. Lawrence	Whiteaves	1
203215	Off Halifax, N. S., 20 fathoms	B. F.	1 v.
111016	Gulf of St. Lawrence	Stimpson	1
49392	Off Nova Scotia, 25 fathoms	B. F.	1
173720	Gaspé Bay, Canada	Whiteaves	1
22751	Gaspé Bay, Canada	Whiteaves	5
173698	Murray Bay, Canada	Dawson	8
111017	"New England" (Maine ?)	Stearns	2
49391	Gulf of Maine, 75 fathoms	B. F.	3 v.
202875	Georges Banks, 45 fathoms	B. F.	1
	PACIFIC HEMISPHERE.		
110983	Seahorse Islands, Arctic Ocean, 25 fathoms	E. E. Smith	12
33808	Pt. Belcher, Arctic Ocean	Dall	1
33804	Off Cape Sabine, Arctic Ocean, 3 fathoms	Dall	1 v.
33805	Off Cape Sabine, Arctic Ocean, 3 fathoms	Dall	1 v.
33807	Off Icy Cape, Arctic Ocean	Dall	1
33803	Off Cape Lisburne, Arctic Ocean	Dall	11
180968	Kotzebue Sound, Arctic Ocean	Washburne	1
223411	Kotzebue Sound, Arctic Ocean	U. S. *Corwin*	1
203835	Eschscholtz Bay, Arctic Ocean	Kindle	3 v.
33806	Point Spencer, Bering Strait	Dall	1
110984	Cape Prince of Wales, 23 fathoms	E. E. Smith	7
223331	Bering Strait, 17 fathoms	Dall	2
223118	Bering Strait, 13 fathoms	Dall	2 v.
209784	Bering Strait	Turner	1
223302	Plover Bay, 20–25 fathoms	Dall	1
61279	Plover Bay	Krause	1
210759	Bering Sea	U. S. *Corwin*	4
210937	Bering Island	Grebnitsky	4
173721	Japan	Capt. St. John	1
210836	St. Paul Island	W. Palmer	4
151612	St. Paul Island	Kincaid	4 v.
215076	St. Paul Island	G. D. Hanna	3 v.
110990	St. Paul Island, 9 fathoms	Dall	3
110991	St. George Island	Dall	2 v.
110985	Nunivak Island, 9 fathoms	Dall	15
110987	Nunivak Island	Dall	7
110889	5 miles west of Nunivak, 24 fathoms	Dall	2
160943	Hagmeister Island, 8–15 fathoms	Dall	1 v.
110992	Attu Island, Saranna Bay	Dall	2

Cat. No.	Locality.	Collector.	Number of specimens.
205905	Petrel Bank, Bering Sea, 54 fathoms	B. F	1
110993	Small Pass, Kyska Island, 10 fathoms	Dall	2
110994	Kyska Harbor	Dall	2 v.
225486	Atka Island	Dall	3
110995	Amchitka Island, 10 fathoms	Dall	1
160999	Amchitka Island	Dall	1 v.
110996	Unalashka Island, 70 fathoms	Dall	4
110999	Unalashka Island, 16 fathoms	Dall	5
110998	Iliuliuk Harbor, 5 fathoms	Dall	2
111000	Iliuliuk Harbor, 15 fathoms	Dall	10
110997	Iliuliuk Harbor, 25 fathoms	Dall	6
160908	Port Levasheff	Dall	1
111001	Akutan Pass	Dall	6
111004	Coal Harbor, Unga Island	Dall	12
111002	Coal Harbor, Unga Island, 8 fathoms	Dall	2
111003	Coal Harbor, Unga Island, l. w	Dall	4
111005	Coal Harbor, Unga Island, 8–9 fathoms	Dall	3
210802	Popoff Strait	Dall	1 v.
223223	Popoff Strait	Dall	9
111007	Nagai Island	Dall	2
111006	Yukon Harbor, 13 fathoms	Dall	3
111008	Simeonoff Island	Dall	1 v.
111009	Semidi Islands, 20 fathoms	Dall	1
111010	Chirikoff Island, 9–14 fathoms	Dall	4
222596	Chignik Bay, 60 fathoms	Dall	1
206411	Southeast of Alaska Peninsula, 21 fathoms	Dall	1
222158	Afognak Bay, 16 fathoms	Dall	1
110988	Kodiak Island	Dall	2 v.
206470	Kodiak Island	Fisher	1
209766	Kodiak, St. Paul	Fisher	20
55781	Kodiak	Fisher	12
224444	Kodiak	B. F	3
111011	Kodiak, St. Paul, 13 fathoms	Dall	3
111012	Kenai, Cooks Inlet	Dall	2
223581	Dundas Bay, Alaska, 10 fathoms	B. F	3
11780	Sitka Harbor, l. w	Dall	20
74232	Sitka Harbor	Hepburn	1
274132	Turn Island, Gulf of Georgia	Oldroyd	1
224351	Puget Sound, 40 fathoms	B. F	6
126076	Astoria, Oregon	White	1

The specimens are in general very uniform. No. 215076, however, is nearly as coarsely striated and ribbed as the New Zealand *H. nigricans*. The largest specimen, No. 6279, measures: width, 30, length 32, and diameter 22 mm.

HEMITHYRIS NIGRICANS Sowerby.

Terebratula nigricans SOWERBY, Proc. Zool. Soc., 1846, p. 91; Thes. Conch., vol. 1, p. 342, pl. 71, figs. 81, 82, 1847.

Rhynchonella nigricans DALL, Amer. Journ. Conch., vol. 6, p. 152, fig. 34, 1870.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 169, pl. 24, figs. 16–19, 1887.

Rhynchonella nigricans var. *pyxidata* WATSON, (in Davidson) *Challenger* Brach., p. 59, pl. 4, fig. 14, 1880.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 170, pl. 24, fig. 20, 1887.

Hemithyris nigricans DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 196.

Type locality.—New Zealand.

Cat. No.	Locality.	Collector.	Number of specimens.
173722	New Zealand	Flower	1
17819	New Zealand	Cuming	1
98954	New Zealand	Kershner	7 v.
102760	New Zealand	Stearns	2
11894	Lyall Bay, New Zealand	Col. Mus	8 v.
11894*a*	Sinclair Head, New Zealand	Col. Mus	8
111018	Stewart Island, New Zealand	C. Traill	11
111019	Bluff Head, New Zealand	Kershner	7 v.

This well known species though frequently distorted, when normally developed is very uniform.

HEMITHYRIS DÖDERLEINI Davidson.

Rhynchonella döderleini Davidson, Ann. Mag. Nat. Hist., ser. 5, vol. 17, p. 1, 1886; Mon. Rec. Brach., pt. 2, p. 172, fig. 19, pl. 25, figs. 14–15, 1887.

Type locality.—Sagami Bay, Japan, in 160 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
297084	China Sea, off Pratas Island., 340 fms	B. F	1 v.
296984	China Sea, off Pratas Island., 230 fms	B. F	3 v.
299761	Sibuko Bay, Borneo, 347 fms	B. F	2 v.

It is to be regretted that the Bureau of Fisheries explorations resulted in obtaining only separated valves of this interesting species, though they largely extended its known geographic range. It seems to be most nearly related to the preceding species which is often imbricated.

HEMITHYRIS LUCIDA Gould.

Rhynchonella lucida Gould, Proc. Boston Soc. Nat. Hist., vol. 7, p. 323, 1860; Otia Conch., p. 120, 1862.—Davidson, Proc. Zool. Soc., 1871, p. 309, pl. 31, figs. 13–14; Mon. Rec. Brach., pt. 2, p. 168, pl. 24, figs. 14–15 *b*, 1887.
Hemithyris lucida Dall, Proc. Acad. Nat. Sci. Phil. for 1873, p. 196.

Type locality.—Off Japan coast at latitude 30° 35′ N. and longitude 130° 40′ east, in 110 fathoms. Captain Stevens.

Cat. No.	Locality.	Collector.	Number of specimens.
111083	Hakodate, Japan	E. S. Morse	60
110827	Hakodate, Japan, 47 fathoms	B. F	2
110828	Eastern Sea, Japan, 139 fathoms	B. F	1 v.
211076	Japan Sea, 44 fathoms	B. F	30
110826	Kagoshima Gulf, 103 fathoms	B. F	10
274133	Otaru, Japan	Morse	2

The color of this species varies from light grey to dark slate color.

HEMITHYRIS CRANEANA Dall.

Hemithyris craneana Dall, Proc. U. S. Nat. Mus., vol. 17, p. 717, pl. 31, figs. 5–6, July, 1895.

Type locality.—Off Cocos Island, Gulf of Panama, at Bureau of Fisheries station 3362, in 1,175 fathoms, mud, bottom temperature 36° 8 F.

Cat. No.	Locality.	Collector.	Number of specimens.
122861	Off Cocos Island, 1,175 fathoms	B. F	1

Only one specimen of this species has so far been obtained.

HEMITHYRIS CORNEA Fischer.

Rhynchonella cornea (Fischer MS.) Davidson, Mon. Rec. Brach., pt. 2, p. 171, pl. 25, figs. 5, 6, 1887.

Rhynchonella (*Hemithyris*) *cornea* Fischer and Oehlert, Exp. Sci. du *Travailleur* et du *Talisman*, p. 13, pl. 1, figs. 2a–2u, 1891.

Type locality.—Off Cape St. Vincent, in 57½ fathoms, *Talisman* Expedition.

Cat. No.	Locality.	Collector.	Number of specimens.
130327	Off Mogador, in 240 fms	*Talisman* Exp	8

This is a well marked species. In the *Talisman* report cited above there seems to be a misprint in the table of dimensions on page 15, 36 and 35 mm. being printed for 26 and 25, respectively.

HEMITHYRIS COLURNUS Hedley.

Hemithyris colurnus Hedley, Records of the Australian Museum, vol. 6, pt. 2, p. 44, text figs. 7, 8, 1905.

Type locality.—Off Cape Byron, in 111 fathoms, and east of Wollongong, Australia, in 100 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
333012	Gabo Island, Victoria	Hedley	4

This species is usually broadly dorsally uniplicate with the margin of the plication a straight line, but in some specimens this line is modified by three small but distinct minor plications, much as in

H. sladeni. It has been referred to *Aetheia* Allan-Thomson, but the Tertiary type of that group is figured by Thomson with a cardinal platform, while in the present species the crura are not united medially.

HEMITHYRIS BARTSCHI, new species.

Shell pellucid gray, thin, rounded-triangular, attenuated behind, widest near the front edge of the valves, anterior margin straight without a trace of flexure; surface shining, with faint incremental and delicate radial lines visible only by magnification; pedicel valve inflated, arcuate, the apex incurved; the beak with, on each side of the foramen, a small spine or projection directed laterally; pseudodeltidia wide, meeting in front of the foramen but not quite coalescent; hinge teeth feeble, supported by the usual props with a narrow cavity between them and the valve; muscular impressions obscure, the inner surface under magnification showing a minute pavement reticulation; brachial valve less convex; hinge plate feeble, divided mesially to the apex, which is somewhat callous; sockets faintly transversely striated; a low septum, less than one-third the length of the valve, extending forward from the cavity of the beak; apophyses short, slender, twisted, with a squared extremity; height of pedicel valve 18, width 16, convexity 7 mm.; height of brachial valve 16, width 16, convexity 5 mm.; length of septum 5 mm.

Type locality.—Off Makyan Island, Molucca Pass, in 298 fathoms, sand; Bureau of Fisheries station 5621.

Cat. No.	Locality.	Collector.	Number of specimens.
239269	Molucca Pass, 298 fathoms	B. F	1
274134	Off Jolo, Philippines, 161 fathoms	B. F	1

The two little horns at the sides of the beak of this species are quite peculiar, but are gradually worn off with age. It is named in honor of Dr. Paul Bartsch, to whose untiring energy the success of the collecting is due. This species differs from *Compsothyris* in that the septum is not bifurcate behind and is not united to any process from below the crura.

Type.—Cat. No. 239269, U.S.N.M.

HEMITHYRIS SLADENI Dall.

Hemithyris sladeni Dall, Trans. Linn. Soc. London, ser. 2, Zoology, vol 13, pt. 3, p. 440, pl. 26, figs. 7-12, 1910.

Type locality.—Indian Ocean south of the Saya de Malha banks, in 153 to 123 fathoms, station C. 1, of the *Sealark* Expedition, 1905.

Cat. No.	Locality.	Collector.	Number of specimens.
111086	Indian Ocean, 153 fathoms	*Sealark* Exp	1

The small duplex angular flexure in front, with the smooth surface, distinguish this from any other known recent species. An exactly similar biplication exists in *Rhynchonella salpinx* Dall, of the Eocene of Wilmington, North Carolina, a fact of which Dr. J. Allan Thomson has expressed himself skeptical.[1] If ventral uniplication is generically important perhaps this peculiarity may be worthy of a sectional name.

Genus NEORHYNCHIA Allan Thomson.

Neorhynchia J. Allan Thomson, Geol. Mag., n. s. dec. 6, vol. 2, p. 388, Sept., 1915.

Shell ventrally uniplicate, foramen hypothyrid.

Type.—*N. strebeli* Dall.

NEORHYNCHIA STREBELI Dall.

Hemithyris strebeli Dall, Bull. Mus. Comp. Zool., vol. 43, p. 441, 1908.

Type locality.—U. S. S. *Albatross*, station 4721, in mid-Pacific, in 2,084 fathoms, ooze, bottom temperature 35° 1 F.

Cat. No.	Locality.	Collector.	Number of specimens.
110741	Mid-Pacific, 2,084 fathoms	B. F	3
110768	Off Galapagos Islands., 2,035 fathoms	B. F	1

In this species the foramen is below the apex of the beak, when complete, but the apex is usually worn off by friction through the animal turning on its pedicel, which is very short. I am inclined to think that this is the explanation of all the supposed epithyrid foramina of the recent Rhynchonellids.

Genus BASILIOLA Dall.

Basiliola Dall, Bull. Mus. Comp. Zool., vol. 43, p. 442, 1908.
Basiola Allan Thomson, Geol. Mag., n. s., dec. 6, vol. 2, p. 390, 1915.

Type.—*B. beecheri* Dall, 1895, Hawaiian Islands.

BASILIOLA BEECHERI Dall.

Hemithyris beecheri Dall, Proc. U. S. Nat. Mus., vol. 17, p. 717, pl. 31, figs. 1, 2, 3, 4, July, 1895.
Basiliola beecheri Dall, Bull. Mus. Comp. Zool., vol. 43, p. 442, 1908.

Type locality.—Hawaiian Islands.

[1] Geological Magazine, n. s., dec. 6, vol. 2, p. 388, 1915.

Cat. No.	Locality.	Collector.	Number of specimens.
107009	Near Hawaiian Islands, types, 313 fathoms	B. F.	3v.
334677	Hawaii, Palolo Channel, 198 fathoms	B. F.	4
334679	Hawaii, West coast, 198 fathoms	B. F.	1
173031	Hawaii, West coast, 198 fathoms, fig'd	B. F.	2
274136	South of Oahu, 252 fathoms	B. F.	1v.
334675	South of Oahu, 211 fathoms	B. F.	1
173034	North of Maui, 178 fathoms, fig'd	B. F.	1
334676	North of Maui, 143 fathoms	B. F.	2
334678	Off Kauai, 309 fathoms	B. F.	1

The crural plates are narrow and deeply excavated, the crura rather long, slightly twisted and concave on their inner faces. The space behind the dental props is very small and solidly filled with cement in the older specimens. The valves are unusually thick, solid and calcareous. Until I got more perfect specimens than the original types, I suspected that the *H. colurnus* of Hedley, might be identical, but with the receipt of perfect individuals an inspection showed sufficient distinctions in and about the cardinalia.

The pedicel tube, homologous with the "collar" of Jackson, but greatly produced and developed, would certainly be taken as of generic value in a fossil species and is not distantly related to the arrangement in the Devonian *Pseudosyrinx*.

BASILIOLA POMPHOLYX, new species.

Shell pellucid, much inflated, light gray, polished, without radial striation and only very faint incremental lines; pedicel valve with a wide concave mesial fold which is not laterally well defined except at the margin where the valve projects in a squarish fashion; the beak is low, the foramen small, under the apex; the deltidial plates wide, firmly united in front of the foramen and produced in a sort of gutter in front; when not worn off the extremity of this gutter extends beyond the plane of the incurved beak; internally the lower extensions of the plates unite without any visible suture to form a broad tube of which the anterior edge is free from the dome of the valve and extends forward as far as the beginning of the dental props; the hinge teeth are very small and weak but strongly cross-striated; a narrow groove extends from under the tube mesially as far as the rather small muscular impressions, the dental props are thin and inconspicuous; the brachial valve is almost hemispherical in inflation, with a broad squarish anterior fold; the crural plates wide, short, separated clear to the apex, the crura very small, short, guttered below; the cavity of the beak sometimes with a low thread-like septum extending forward to the muscular scars, sometimes with a shallow groove which after separating the muscular impressions bifurcates widely, extending nearly to the anterior margin. Height of shell 26; width 28; maximum diameter 17 mm.

Type locality.—Sibuko Bay, Borneo, at station 5592, South of Silungan Island, in 305 fathoms, mud, bottom temperature 43° 3 F.

Cat. No.	Locality.	Collector.	Number of specimens.
274135	Off Panaon Island, Philippine Islands, 585 fathoms	B. F	1
300863	Off Eastern Luzon, Philippine Islands, 153 fathoms.	B. F	1v.
300936	Off Eastern Luzon, Philippine Islands, 500 fathoms.	B. F	1
300668	Off Cagayan Island, Philippine Islands, 495 fathoms.	B. F	1v.
300769	Off Eastern Palawan Island, Philippine Islands, 1,105 fathoms.	B. F	1v.
235844	Off Sulade Island, Philippine Islands, 24 fathoms.	B. F	2
299918	Off Silungan Island, Philippine Islands, 305 fathoms.	B. F	1½
291071	Off Silungan Island, Philippine Islands, 305 fathoms.	B. F	4v.
299983	Off Silungan Island, Philippine Islands, 305 fathoms.	B. F	1v.
229301	Sibuko Bay, Borneo, types, 305 fathoms	B. F	4
300266	Celebes, 540 fathoms	B. F	1v.

Genus FRIELEIA Dall.

Frieleia DALL, Proc. U. S. Nat. Mus., vol. 17, p. 713, 1895.

FRIELEIA HALLI Dall.

Frieleia halli DALL, Proc. U. S. Nat. Mus., vol. 17, p. 714, pl. 24, figs. 6, 9–13, 1895.

Type locality.—Cortez Bank, California coast, in 984 fathoms, bottom temperature 38° F., U. S. Fish Commission station 2919.

Cat. No.	Locality.	Collector.	Number of specimens.
110512	Off Avacha Bay, Kamchatka, 682 fathoms	B. F	14
110830	Off Avacha Bay, Kamchatka, 682 fathoms	B. F	12
204679	Off Hondo, Japan, 302 fathoms	B. F	1
206363	Bristol Bay, Alaska, ? 4½ fathoms	B. F	1
331743	Southeast of Alaska, Pena, 21 fathoms	B. F	1v.
110829	Off Bowers Bank, 764 fathoms	B. F	3v.
274137	Off British Columbia, 204 fathoms	B. F	1
111021	Off coast of Washington, 559 fathoms	B. F	10
331098	Off coast of Oregon, 93 fathoms	B. F	3
223533	Sta. Barbara Channel, 500 fathoms	B. F	3v.
266869	Off Point Sur, California, 659 fathoms	B. F	6
123148	Off Cortez Bank, 984 fathoms	B. F	1
210093	Southwest of Point Loma, California, 680 fathoms.	B. F	2
211178	Southwest of Point Loma, California, 650 fathoms.	B. F	5
107010	Off San Diego, California, 522 fathoms	B. F	2
111020	Off San Diego, California, 822 fathoms	B. F	20
209044	Off San Diego, California, 822 fathoms	B. F	2
209381	Off San Diego, California, 1,059 fathoms	B. F	1v.
209242	Off San Diego, California, 640 fathoms	B. F	1v.
331000	Off San Diego, California, 822 fathoms	B. F	3
130501	Off San Diego, California, 623 fathoms	B. F	6

The specimens from the cold water off Kamchatka were much coarser and more solid than the others, but otherwise similar. A considerable proportion of the specimens are more or less distinctly bilobed, this condition not being accidental, as supposed by Doctor Thomson, while others show hardly a trace of lobation. Both valves are medially more or less concave, the sulcation, if it may be called so, being "opposite." It is much less evident in specimens from colder water.

Genus ATRETIA Gwyn Jeffreys.

Cryptopora JEFFREYS, Nature, vol. 1, p. 136, Dec. 2, 1869; not *Cryptoporus* Motschulsky, 1858 (*Coleoptera*).

Atretia JEFFREYS, Proc. Royal Society, No. 121, p. 421, 1870; Ann. Mag. Nat. Hist., Sept., 1876, p. 251; Proc. Zool. Soc. London, Apr. 16, 1878, p. 412, pl. 23, fig. 4, *a–c*.—DAVIDSON, Mon. Rec. Brach, pt. 2, p. 173, pl. 25, figs. 6–13, 1887. Not *Atretium* Cope, 1861.

Neatretia FISCHER and OEHLERT, Exp. Sci. *Travailleur* et *Talisman*, p. 122, 1891.

Type.—*A. gnomon* Jeffreys.

Current nomenclatorial usage would reject *Cryptopora* as homonymous with *Cryptoporus*, but whether the practice would extend so far as to reject *Atretia* on account of *Atretium* is more doubtful. My own feeling is in favor of retaining *Atretia* as valid.

ATRETIA GNOMON Jeffreys.

Cryptopora gnomon JEFFREYS, Nature, Dec. 2, 1869, p. 136.

Atretia gnomon JEFFREYS, Proc. Roy. Soc., No. 121, p. 421, 1870.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 173, pl. 25, figs. 6–13, 1887.

Neatretia gnomon FISCHER and OEHLERT, Exp. Sci. *Travailleur* et *Talisman*, p. 122, fig. 11 *a–c*, 1891.

Type locality.—North Atlantic, northwest of Ireland.

Cat. No.	Locality.	Collector.	Number of specimens.
206479	Off Tromsö, Norway, 650 fathoms	N. Atl. Exp. st. 192	1
173631	North Sea	N. Atl. Exp.	1
173627	Northwest of Ireland (cotype)	*Porcupine* Exp.	1
173626	North Atlantic 1,785 fathoms	*Valorous* Exp.	2
173625	Davis Straits, 1,000 fathoms	*Valorous* Exp.	1
173624	Davis Straits, 1,450 fathoms	*Valorous* Exp.	1
130340	North of Azores, 2,200 fathoms	*Talisman* Exp.	1
46150	South of Marthas Vineyard, 1,537 fathoms	B. F.	1
44911	South of Marthas Vineyard, 1,525 fathoms	B. F.	Many.
46149	Off Maryland, 1,594 fathoms	B. F.	1
83131	Off Fowey Rocks, Florida, 205 fathoms	Dr. Rush	6
274138	Off Fowey Rocks, Florida, 100 fathoms	Henderson	12
274139	Off Key West, Florida, 120 fathoms	Henderson	14
94367	Off Cuba, 780 fathoms	Dr. Rush	4
336894	Off Cuba, 150 fathoms	Henderson	1

The younger specimens show radial striation, which is less evident or absent in the adults.

ATRETIA BRAZIERI Crane.

Atretia brazieri (Davidson MS.) CRANE, Proc. Zool. Soc., 1886, p. 183; Mon. Rec. Brach., App., p. 175, pl. 25, figs. 16–17*a*, 1887.

Cryptopora brazieri ALLAN THOMSON, Austr. Antarctic Exp., Brach., p. 43, June, 1918.—HEDLEY, Proc. Linn. Soc. New South Wales, vol. 31, pt. 3, p. 467, pl. 36, figs. 1–2, 1906.

Type locality.—Port Stephens, New South Wales, in 25 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
335705	Off Wollongong, New South Wales, 100 fathoms.	Hedley............	10

Some of the specimens have the pedicel valve medially furrowed externally, other not. The species is remarkably like the *A. gnomon*.

Family TEREBRATULIDAE.

Genus TEREBRATULINA Orbigny.

Terebratulina ORBIGNY, Comptes Rendus Acad. Sci., vol. 25, p. 268, 1847.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 17, 1887.

TEREBRATULINA RETUSA Linnaeus.

Anomia retusa LINNAEUS, Syst. Nat., ed. 10, p. 701, 1758; ed. 12, p. 1151, 1767.—HANLEY, Shells of Linnaeus, p. 123, 1855.

Anomia pubescens LINNAEUS, Syst. Nat., ed. 12, p. 1153, 1767.

Anomia caput-serpentis LINNAEUS, Syst. Nat., ed. 12, p. 1153, 1767.—RETZIUS. Dissert. Nova test. Gen., p. 13, 1788. Not of Linnaeus, Syst. Nat., ed. 10, p. 703, 1758, nor of Solander, 1797.

Terebratula pubescens MÜLLER, Prodr. Zool. Danicae, p. 249, 1776.—RETZIUS, Dissert, Nova test. Gen., p. 15, 1788.

Terebratula retusa RETZIUS, Dissert. Nova test. Gen., p. 14, 1788.

Terebratula aurita FLEMING, Philos. Zool., pt. 2, p. 498, pl. 4, fig. 5, 1822; Brit. Anim., p. 369, 1828.

Terebratula costata LOWE, Zool. Journ., vol. 2, p. 105, pl. 5, figs. 8, 9, 9*b*, 1825 (young).

Terebratula caput-serpentis SOWERBY, Thesaurus, *Terebratula*, p. 343, pl. 68, figs. 2, 3, 4; pl. 72, fig. 116, 1847.

Delthyris spatula MENKE, Syn. Meth. Moll., ed. 2, p. 96, 1830.

Terebratula striata LEACH, Syn. Moll. Gt. Brit., p. 359, pl. 13, figs. 1, 2, 1852.

Terebratulina caputserpentis ORIBGNY, Ann. Sci. Nat., vol. 8, p. 67, pl. 7, figs. 7, 8, 1848.—DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 365, 1852; Mon. Rec. Brach., pt. 2, p. 17, pl. 3, fig. 12; pl. 4, figs. 1–11; pl. 5, figs. 32–34, 1886.

Type locality.—Norwegian coast.

TEREBRATULINA RETUSA EMARGINATA Risso.

Terebratula emarginata RISSO, Hist. Nat. Eur. Mér., vol. 4, p. 388, fig. 175, 1826.

Terebratula quadrata RISSO, Hist. Nat. Eur. Mér., vol. 4, p. 389, fig. 176, 1826.

Terebratula caputserpentis PHILIPPI, En. Moll. Sicil., vol. 2, p. 94, pl. 6, figs. 5*a–b*, 1830.

Terebratula chemnitzii KÜSTER, Conch. Cab., ed. 2, *Terebratula*, p. 97, pl. 2*b*, figs. 19, 20, 1868.

Terebratula caputserpentis var. *mediterranea* JEFFREYS, Proc. Zool. Soc., 1878, p. 401.

Type locality.—Mediterranean.

TYPICAL FORM.

Cat. No.	Locality.	Collector.	Number of specimens.
173501	Fig'd. Brit. Conch., Vol. II	Jeffreys	3
173503	Fig'd. Brit. Conch., Vol. II., pl. 1, fig. 1		1
173502	Fig'd. Brit. Conch., Vol. V		3
152570	Murman coast	Hertzenstein	2
25523	Lofoten Islands	M. Sars	8
173504	Zetland	Barlee	30
173505	Zetland	Jeffreys	50
173506	Zetland	Jeffreys	10
173507	Shetland Islands	Jeffreys	2
173508	Shetland Islands	Barlee	6
73157	Norway	Stimpson	5
173509	Shetland Islands	Jeffreys	3
173510	Shetland Unsthaf	Jeffreys	20
173511	Shetland Unsthaf	Jeffreys	2
173512	Shetland Unsthaf	Jeffreys	4
110901	Oban, Scotland	Stimpson	11
74792	Oban, Scotland	Walpole	8
173515	Oban, Scotland	Barlee	10
173516	Oban, Scotland	(Fry)	70
173517	Oban, Scotland	Jeffreys	Many.
173513	Lerwich, Scotland	Jeffreys	1
173514	Inverary, Scotland	A. Munro	3
173518	Argyleshire	Jeffreys	3
173519	Hebrides	Jeffreys	30
173520	Skye	Barlee	3
173521	Skye	Barlee	5
173522	Skye	Barlee	50
173523	Skye	Jeffreys	10
173524	Skye	Jeffreys	40
173525	Croulin Island	Jeffreys	4
173526	Croulin Island	Jeffreys	10
173527	Loch Carron	Jeffreys	20
173528	Loch Tyre	Jeffreys	6
173529	Loch Fyne	McNab	7
173531	Loch Duich	Barlee	7
173534	Loch Torridon	Jeffreys	2
173530	Scotland	Jeffreys	6
13187	Scotland	McAndrew	5
77274	Scotland	Stimpson	6
334777	West coast of Scotland	Jeffreys	5
170248	Firth of Clyde, 95 fathoms	Jeffreys	11
173535	North of Scotland, 363 fathoms	*Porcupine* Exp	4
173536	North of Scotland, 632 fathoms	*Porcupine* Exp	3½
173537	North of Scotland; 114 fathoms	*Porcupine* Exp	1
173538	North of Scotland, 345 fathoms	*Porcupine* Exp	2+
173539	North of Scotland, 200 fathoms	*Porcupine* Exp	4
173540	North of Scotland, 250 fathoms	*Porcupine* Exp	3
173541	North of Scotland, 560 fathoms	*Porcupine* Exp	1
173542	North of Scotland, 290 fathoms	*Porcupine* Exp	4
173543	North of Scotland, 155 fathoms	*Porcupine* Exp	3
173545	Station 4, 530 fathoms	*Lightning* Exp	2
173546	Off Belfast, Ireland	Jeffreys	4
173547	Belfast Bay	Jeffreys	12
173548	Belfast Bay (young)	Humphreys	1
173549	Belfast Bay	Jeffreys	1
173550	Arran Island	Barlee	1
173551	Larne (young)	Barlee	6
173552	Northwest of Ireland, 420 fathoms	*Porcupine* Exp	2
173553	Northwest of Ireland, 164 fathoms	*Porcupine* Exp	1
173554	West of Ireland, 808 fathoms	*Porcupine* Exp	2

Cat. No.	Locality.	Collector.	Number of specimens.
173555	West of Ireland, 90 fathoms	*Porcupine* Exp	1
173556	West of Ireland, 173 fathoms	*Porcupine* Exp	1
173557	West of Ireland, 109 fathoms	*Porcupine* Exp	1
88978	Britain	Carpenter	2
11891	Britain	Damon	11
110903	Britain	Dall	7
110900	Britain	Carpenter	1
131045	"Europe"	Lea Coll	1
110902	North Atlantic, 345 fathoms	Jeffreys	4
173558	Off Lands End	Anderson	1
173560	Osterfiord, Norway	Jeffreys	1
173561	Vallo, Norway	G. O. Sars	2
173562	Dröbak, Norway	Jeffreys	2
173563	(Deformed), Norway	Jeffreys	1
173565	Cape Breton, France	De Folin	1

Variety EMARGINATA Risso.

Cat. No.	Locality.	Collector.	Number of specimens.
305083	Mediterranean	S. Smith	1
130331	Off Morocco, 50 fathoms	*Talisman* Exp	3
173566	Coast of Morocco, 207 fathoms	*Porcupine* Exp	2
173574	West of Soloom Bay, Tunis, 40–120 fathoms	*Shearwater* Exp	9
173573	Skerke Bank, Tunis, 30–120 fathoms	*Shearwater* Exp	5
173569	Adventure Bank, Tunis, 50–130 fathoms	*Shearwater* Exp	7
173568	Adventure Bank, 92 fathoms	*Porcupine* Exp	1
173572	Benzert Roads, Tunis	*Shearwater* Exp	1
173575	Corsica	Susini	6
173581	Naples	Tiberi	4
173589	Adriatic Sea	Issel	3
173588	(Fry)	Jeffreys	6

Variety ANGUSTATA Jeffreys.

Cat. No.	Locality.	Collector.	Number of specimens.
173533	Loch Duich, Scotland	Jeffreys	3

Variety GRANDIS Jeffreys.

Cat. No.	Locality.	Collector.	Number of specimens.
173571	Benzert Roads, Tunis	*Shearwater* Exp	20

Hanley showed in his review of the Linnean shells in 1855 that the original *Anomia caput-serpentis* of Linnaeus in 1758 is a fossil smooth Terebratuloid, probably from the Italian Tertiary, while the recent shell we have been accustomed to call *caput-serpentis* is described in the same publication two pages earlier under the name *retusa*. It is perfectly obvious that the name *caput-serpentis* is excluded from use in the latter connection by all rules. Those who retain some skepticism will do well to consult Hanley's book.

It appears that the spiculation of the Mediterranean form differs from that of the North of Europe species and Blochmann confirms the opinion of Davidson that the former should be regarded as distinct.

The earliest name for the Mediterranean form is *emarginata* of Risso, but the bilobate form is not peculiar to Mediterranean specimens. There are in the Jeffreys collection numerous specimens of *retusa* with this character, and in fact bilobation seems to occur in almost any of the less inflated strongly striated species of the genus as a mutation. The varieties *angustata* and *grandis* of Jeffreys seem to me mere mutations of form, without special significance. On the other hand *T. septentrionalis* and *T. unguicula*, which have been frequently treated as varieties of *T. retusa*, are positively established as distinct species by Blochmann on the basis of their spiculation although it is often extremely difficult to separate them merely on the basis of the shells.

TEREBRATULINA SEPTENTRIONALIS Couthouy.

Terebratula septentrionalis Couthouy, Boston Journ. Nat. Hist., vol 2, p. 65, pl. 3, fig. 18, 1838.—Sowerby, Thesaurus, *Terebratula*, p. 344, pl. 68, fig. 18, 1847.

Terebratula caputserpentis Gould, Inv. Mass., p. 141, 1841.—Reeve, Conch. Icon., *Terebratula*, pl. 4, text only, 1860; not of authors.

Terebratulina septentrionalis Stimpson, Checklist of Sh. of N Am. East Coast, p. 2, No. 61, 1860; Binney's Gould's Inv. Mass., p. 208, fig. 500, 1870.—Davidson, Mon. Rec. Brach., pt. 1, p. 28, pl. 5, figs. 1–31, 43–52, 1886.

Cat. No.	Locality.	Collector.	Number of specimens.
274155	Finmark	Jeffreys	17
173559	Vadsö, Norway	G. O. Sars	1
173638	Vadsö, Norway	G. O. Sars	1
173532	Loch Duich, Scotland	Jeffreys	6
173544	Station 6	*Valorous* Exp	1
49300	Off Cape Sable, Nova Scotia	B. F	4
203033	Off Cape Sable, Nova Scotia	B. F	1
110866	Le Have Bank, Nova Scotia, 150 fathoms	Olsen	1
110864	Nova Scotia, 60 fathoms	Proctor	3
110865	Nova Scotia	Stearns	2
49301	Nova Scotia, 59 fathoms	B. F	1
49311	Nova Scotia, 47 fathoms	B. F	8
49315	Nova Scotia, 42 fathoms	B. F	1
153526	Bedford Basin, Nova Scotia, 33–40 fathoms	B. F	4
153539	Near Halifax, Nova Scotia, 127 fathoms	B. F	1
49318	Halifax, Nova Scotia 43 fathoms	B. F	2
203038	Halifax, Nova Scotia, 20 fathoms	B. F	1
203036	Off Halifax, Nova Scotia, 16 fathoms	B. F	3
49309	Off Halifax, Nova Scotia, 16 fathoms	B. F	1 v.
49312	Off Halifax, Nova Scotia, 43 fathoms	B. F	1
49314	Off Halifax, Nova Scotia, 42 fathoms	B. F	2
49319	Off Halifax, Nova Scotia	B. F	4
49320	Off Halifax, Nova Scotia, 51 fathoms	B. F	2
49273	Bay of Fundy, Nova Scotia	B. F	2
203037	Bay of Fundy, Nova Scotia, 40–55 fathoms	B. F	5
110874	Grand Banks	Stimpson	1
151751	Grand Banks, 150 fathoms	Stimpson	1
27541	Grand Manan Island, Maine	Stimpson	6
49271	Grand Manan Island, Maine	B. F	6
49272	Grand Manan Island, Maine	B. F	14
153523	Grand Manan Island, Maine, 28–52 fathoms	B. F	5
49270	Eastport, Maine	B. F	Many.
73276	Eastport, Maine	Stimpson	10
110868	Eastport, Maine	Stimpson	5 v.

Cat. No.	Locality.	Collector.	Number of specimens.
110869	Eastport, Maine	Verrill	16
131046	Eastport, Maine	Cooper	9
131047	Eastport, Maine	Dr. Jay	2
173585	Eastport, Maine	Fuller	1
173586	Eastport, Maine	Skelton	1
173587	Eastport, Maine	Verrill	1
334778	Off Little Hope Light	G. K. Allen	2
27541	Gulf of Maine	Stimpson	1
49287	Gulf of Maine, 25 fathoms	B. F	10
49288	Gulf of Maine, 105 fathoms	B. F	9
49294	Gulf of Maine, 35 fathoms	B. F	Many.
59691	Gulf of Maine	F. Stearns	4
59683	Gulf of Maine	Stimpson	10
77567	Gulf of Maine, 54 fathoms	B. F	11
77568	Gulf of Maine	B. F	1
77569	Gulf of Maine, 100-110 fathoms	B. F	2
77570	Gulf of Maine, 68 fathoms	B. F	1
110870	Gulf of Maine	Dr. Stearns	2
120153	Gulf of Maine	McGuire	1
153521	Gulf of Maine, 29 fathoms	B. F	8
153522	Gulf of Maine, 85 fathoms	B. F	12
153528	Gulf of Maine, 75 fathoms	B. F	1
153530	Gulf of Maine, 75 fathoms	B. F	1
153529	Gulf of Maine, 85 fathoms	B. F	1
153531	Gulf of Maine, 110 fathoms	B. F	6
203039	Gulf of Maine	B. F	20
49281	Cashe's Ledge, Maine, 52-90 fathoms	B. F	Many.
49289	Cashe's Ledge, Maine, 27 fathoms	B. F	3
49290	Cashe's Ledge, Maine, 110 fathoms	B. F	10
49291	Cashe's Ledge, Maine, 40 fathoms	B. F	3
49292	Cashe's Ledge, Maine, 92 fathoms	B. F	1
110867	Casco Bay, Maine	Fuller	30
49276	Casco Bay, Maine	B. F	Many.
49283	Casco Bay, Maine, 33 fathoms	B. F	1
203040	Casco Bay, Maine	B. F	2
49329	Off Cape Ann, Massachusetts, 18 fathoms	B. F	2
49332	Off Cape Ann, Massachusetts, 32 fathoms	B. F	2
153518	Off Cape Ann, Massachusetts, 53 fatnoms	B. F	15
153524	Off Cape Ann, Massachusetts, 40 fathoms	B. F	1
153525	Off Cape Ann, Massachusetts, 19 fathoms	B. F	12
153535	Off Cape Ann, Massachusetts, 38 fathoms	B. F	1
203035	Gloucester, Massachusetts	B. F	10
203206	Eastern Point, Massachusetts, 35 fathoms	B. F	3
49295	Off Salem, Massachusetts, 22 fathoms	B. F	20
49296	Off Salem, Massachusetts, 35 fathoms	B. F	1
49302	Off Salem, Massachusetts, 33 fathoms	B. F	2
49304	Off Salem, Massachusetts, 20 fathoms	B. F	3
49306	Off Salem, Massachusetts, 50 fathoms	B. F	8
49308	Off Salem, Massachusetts, 19½ fathoms	B. F	2
49310	Off Salem, Massachusetts, 26 fathoms	B. F	1
49322	Off Salem, Massachusetts, 36 fathoms	B. F	2
49323	Off Salem, Massachusetts, 48 fathoms	B. F	10
203034	Off Salem, Massachusetts, 45 fathoms	B. F	3
274176	Boston Harbor, Massachusetts, 16 fathoms	B. F	5
34881	Off Georges Banks, Massachusetts, 99 fathoms	B. F	Many.
34914	Off Georges Banks, Massachusetts, 65 fathoms	B. F	Many.
35096	Off Georges Banks, Massachusetts, 99½ fathoms	B. F	5
49274	Off Georges Banks, Massachusetts, 150 fathoms	B. F	4
49275	Off Georges Banks, Massachusetts	B. F	2
50601	East of Georges Banks, Massachusetts, 111 fathoms.	B. F	3
50603	East of Georges Banks, Massachusetts, 72 fathoms.	B. F	9

Cat. No.	Locality.	Collector.	Number of speci-
50605	East of Georges Banks, Massachusetts, 677 fathoms.	B. F.	1
110872	Georges Banks, Massachusetts, 45 fathoms	S. Smith	5
110873	Georges Banks, Massachusetts	Schr. *Sultana*	6
203041	Georges Banks, Massachusetts, 101 fathoms	B. F.	2
49293	On Platts Banks, Massachusetts, 32 fathoms	B. F.	2
49298	Massachusetts Bay, 90 fathoms	B. F.	2
49324	Massachusetts Bay, 17 fathoms	B. F.	5
49325	Massachusetts Bay, 23 fathoms	B. F.	5
49326	Massachusetts Bay, 19 fathoms	B. F.	2
49327	Massachusetts Bay, 28 fathoms	B. F.	4
49330	Massachusetts Bay, 26 fathoms	B. F.	1
49331	Massachusetts Bay, 19 fathoms	B. F.	2
49342	Massachusetts Bay, 22 fathoms	B. F.	2
77566	Massachusetts Bay, 16 fathoms	B. F	2
77571	Massachusetts Bay, 35 fathoms	B. F.	9
77573	Massachusetts Bay, 19 fathoms	B. F.	2
110871	Massachusetts Bay	Dall	1
153520	Massachusetts Bay, 22 fathoms	B. F.	6
153532	Massachusetts Bay, 26 fathoms	B. F	1
153533	Massachusetts Bay, 26 fathoms	B. F.	5
45876	Off Cape Cod, Massachusetts, 90 fathoms	B. F.	5
49333	Off Cape Cod, Massachusetts, 18 fathoms	B. F	5
49334	Off Cape Cod, Massachusetts, 16 fathoms	B. F.	9
49336	Off Cape Cod, Massachusetts, 80 fathoms	B. F.	9
49337	Off Cape Cod, Massachusetts, 72 fathoms	B. F	6
49338	Off Cape Cod, Massachusetts, 135 fathoms	B. F.	4
49339	Off Cape Cod, Massachusetts, 67 fathoms	B. F	6
49340	Off Cape Cod, Massachusetts, 45 fathoms	B. F.	2
49341	Off Cape Cod, Massachusetts, 75 fathoms	B. F	10
49343	Off Cape Cod, Massachusetts, 7 fathoms	B. F	2
49345	Off Cape Cod, Massachusetts, 46 fathoms	B. F.	6
49346	Off Cape Cod, Massachusetts, 96 fathoms	B. F	5
153534	Off Cape Cod, Massachusetts, 12 fathoms	B. F.	1
202884	Off Cape Cod, Massachusetts, 67 fathoms	B. F.	4
40186	Off Nantucket Shoals, Massachusetts, 250 fathoms.	B. F.	13
153527	Nantucket Island, Massachusetts, 5 fathoms	B. F.	2
110875	Marthas Vineyard, Massachusetts, 1,976 fathoms.	B. F.	1
34685	Marthas Vineyard, Massachusetts, 197 fathoms.	B. F.	14
35297	Marthas Vineyard, Massachusetts, 209 fathoms.	B. F.	8
35632	Marthas Vineyard, Massachusetts, 197 fathoms.	B. F.	3
40105	South of Marthas Vineyard, Massachusetts, 195 fathoms.	B. F.	Many.
45881	South of Marthas Vineyard, Massachusetts, 193 fathoms.	B. F.	
45874	Marthas Vineyard, Massachusetts, 192 fathoms.	B. F.	1
45875	Marthas Vineyard, Massachusetts, 238 fathoms.	B. F.	1
45877	Marthas Vineyard, Massachusetts, 245 fathoms.	B. F.	5
45879	Marthas Vineyard, Massachusetts, 291 fathoms.	B. F.	5
45880	Marthas Vineyard, Massachusetts, 225 fathoms.	B. F.	6
51327	Marthas Vineyard, Massachusetts, 317 fathoms.	B. F.	15
51328	Marthas Vineyard, Massachusetts, 264 fathoms.	B. F.	20
51329	Marthas Vineyard, Massachusetts, 225 fathoms.	B. F.	10
51332	Marthas Vineyard, Massachusetts, 234 fathoms.	B. F.	10
153536	Marthas Vineyard, Massachusetts, 396 fathoms.	B. F.	1
203032	Marthas Vineyard, Massachusetts, 458 fathoms.	B. F.	30
203096	Marthas Vineyard, Massachusetts, 458 fathoms.	B. F.	10
153538	Off Newport, R. I., 21 fathoms	B. F.	5
153519	Off Block Island, R. I.	B. F.	20
153537	Fishers Island, New York, 5 fathoms	B. F.	1
202882	Fishers Island Sound, New York, 7 fathoms.	B. F.	1
202883	Fishers Island (?), New York	B. F.	3

This species can generally be distinguished from *T. retusa* by its finer sculpture and more oval form, but varieties approach one another very closely so far as external aspect is concerned. The usual mutations of form occur very often. This species is subject to the (commensal ?) growth of a sponge which when young appears like a normal pubescence, as in *T. retusa,* but when full grown becomes a spongy ball in which the brachiopod is entirely concealed.

The north European specimens appear to be correctly identified, but their spicules have not been examined.

TEREBRATULINA UNGUICULA Carpenter.

Terebratula unguicula CARPENTER, Proc. Zool. Soc., 1865, p. 201, figs. 1–4.

Terebratulina unguicula DALL, Cat. Rec. Brach., Proc. Acad. Nat. Sci. Phila. for 1873, p. 177; 1877, p. 156.

Terebratulina caputserpentis var. *ungicula* DAVIDSON, Mon. Rec. Brach., pt. 1, p. 25, 1886.—DALL, Proc. U. S. Nat. Mus., vol. 17, No. 1032, p. 719, pl. 32, figs. 2, 5, 1895.

Type locality.—Monterey, California. Doctor Cooper.

Cat. No.	Locality.	Collector.	Number of specimens.
15264	Monterey, California (cotype) 20 fathoms	Cooper	1
224264	Off Pribilof Islands, Alaska, 150 fathoms	B. F.	9
224370	Off Pribilof Islands, Alaska, 150 fathoms	B. F.	1
224282	Off Pribilof Islands. Alaska, 121 fathoms	B. F.	2
130518	Off Pribilof Islands, Alaska, 121 fathoms	B. F.	2
224281	Off Pribilof Islands, Alaska, 121 fathoms	B. F.	10
206729	Off Pribilof Islands, Alaska, 142 fathoms	B. F.	1
204672	Off Avacha Bay, 682 fathoms	B. F.	20
212823	West of Unalaska, Alaska, 576 fms	B. F.	1
123152	North of Unalaska, Alaska, 351 fathoms	B. F.	3
212826	North of Unalaska, Alaska, 350 fathoms	B. F.	1
222289	North of Unalaska, Alaska, 309 fathoms	B. F.	1
222290	North of Unalaska, Alaska, 309 fathoms	B. F.	1
110893	Harbor of Unalaska, 80 fathoms	Dall	2 v.
110888	Bay of Unalaska, Alaska, 60 fathoms	Dall	3
123155	Iliuliuk Harbor, Alaska, 85 fathoms	B. F.	12
224004	Ridge, Unalaska, Alaska, 60 fathoms	Dall	2
222271	Captains Bay, Unalaska, 85 fathoms	Dall	2
222272	Captains Bay, Unalaska, 85 fathoms	Dall	2
212824	Captains Bay, Unalaska, 85 fathoms	Dall	3
206508	South of Unimak Island, Alaska, 61 fathoms	B. F.	1
224009	South of Unimak Island, Alaska, 61 fathoms	B. F.	3
212820	South of Unimak Island, Alaska, 61 fathoms	B. F.	12
110890	Off Nagai Island, Alaska, 75 fathoms	Dall	1
110889	Pirate Cove, Alaska	Dall	1
222223	Chignik Bay, Alaska, 42 fathoms	B. F.	4
222595	Chignik Bay, Alaska, 60 fathoms	B. F.	3
222204	Chignik Bay, Alaska, 28 fathoms	B. F.	4
224578	Southeast of Alaska Peninsula, 110 fathoms	B. F.	5
228762	Southeast of Alaska, Peninsula, 58 fathoms	B. F.	1
222397	Southeast of Alaska Peninsula, 68 fathoms	B. F.	2
222181	Shelikoff Strait, Alaska, 56 fathoms	B. F.	3
222159	Afognak Bay, Alaska, 16 fathoms	B. F.	5
224443	Kodiak Islands, Alaska	B. F.	1
55820	Kodiak Islands, Alaska	Fisher	1
226049	Uyak Bay, 66 fathoms	B. F.	3

Cat. No.	Locality.	Collector.	Number of specimens.
110891	Port Etches, 15 fathoms	Dall	10
110892	Port Etches, 15 fathoms	Dall	8
223637	Dundas Bay, 78 fathoms	B. F	1
222292	Lynn Canal, 300 fathoms	B. F	2
222198	Kasaan Bay, 95 fathoms	B. F	3
208928	Gastineau Channel, 80 fathoms	Harriman Exp	7
226211	Sumner Strait, 218 fathoms	B. F	1
222130	Behm Canal, 175 fathoms	B. F	2
222153	Behm Canal, 65 fathoms	B. F	4
222557	Behm Canal, 63 fathoms	B. F	2
222154	Behm Canal, 85 fathoms	B. F	1
226218	Stephens Passage, 188 fathoms	B. F	2
216401	Forrester Island, 50 fathoms	Willett	1
226250	Queen Charlotte Sound, 107 fathoms	B. F	3
226129	Queen Charlotte Sound, 145 fathoms	B. F	1
110894	Off British Columbia, 238 fathoms	B. F	9
222202	Gulf of Georgia, 190 fathoms	B. F	6
223566	Gulf of Georgia, 195 fathoms	B. F	1
110895	Victoria, British Columbia	Fisher	1
110896	Victoria, British Columbia 16 fathoms	Richardson	5
210211	Fuca Straits, 34 fathoms	B. F	1
206725	Fuca Straits, 152 fathoms	B. F	1
224478	Fuca Straits, 135 fathoms	B. F	1
224567	Fuca Straits, 115 fathoms	B. F	2
274169	San Juan Ids., 35 fathoms	Oldroyd	4
133288	Port Orchard, 60 fathoms	Johnson	1
123154	Santa Cruz, California 240 fathoms	B. F	1
209342	Santa Barbara, California, 38 fathoms	B. F	1
110897	Santa Cruz, Island, 155 fathoms	B. F	25
130403	Santa Cruz Island, 31 fathoms	B. F	4
209639	San Miguel Island, 53 fathoms	B. F	1
209352	Santa Rosa Island., 41 fathoms	B. F	1
110824	Anacapa Island	B. F	2
334581	La Jolla, California	Orcutt	7
334666	La Jolla, California	Ritter	1
109604	Point Loma, California, 15 fathoms	Hemphill	3
308966	Pacific Beach, California	Orcutt	1
73914	San Diego, California	Stearns	3
211745?	Cape San Lucas, 21 fathoms	B. F	3 yo.

This species in the North Pacific takes the place which *T. retusa* holds in the North Atlantic. The two species are chiefly differentiated by the character of their spiculae.

TEREBRATULINA VALDIVIAE Blochmann.

Terebratulina valdiviae Blochmann, Zeitsch. für Wiss. Zoologie, vol. 90, pp. 601, 639, pl. 36, figs. 5, 6, 1908.

Type locality.—Off Nias, Sumatra, *Valdivia* Expedition.

Cat. No.	Locality.	Collector.	Number of specimens.
110437	Cotypes, Sumatra, 366 fathoms	Blochmann	2
110823	Off Avacha Bay, 682 fathoms	B. F	20
110843	Korea	Dall	1
204673	Gulf of Tartary, 673 fathoms	B. F	1
110844	Off Honshu Island, Japan, 265 fathoms	B. F	1

Cat. No.	Locality.	Collector.	Number of specimens.
204675	Off Hondo Island, Japan, 65 fathoms	B. F	1
299971	Off Silungan, Philippine Islands, 305 fathoms.	B. F	1
291070	Off Silungan, Philippine Islands, 305 fathoms.	B. F	1½
238829	Off Mindanao, Philippine Islands, 182 fathoms.	B. F	40
298972	Off Mindanao, Philippine Islands, 219 fathoms.	B. F	3 v.
238814	Off Mindanao, Philippine Islands, 169 fathoms.	B. F	3
298947	Off Mindanao, Philippine Islands, 219 fathoms.	B. F	3 v.
291236	Off Tawitawi, Philippine Islands, 240 fathoms.	B. F	3
238895	Off Cebu, Philippine Islands, 310 fathoms	B. F	15
246335	Off North Burias, Philippine Islands, 105 fathoms.	B. F	12 v.
240100	Off (?) Philippine Islands	B. F	1
238214	China Sea, 340 fathoms	B. F	1
297057	China Sea, 230 fathoms	B. F	1
239310	Molucca Pass, 265 fathoms	B. F	1
173591	Australia (?)	Flower	1

This species much resembles *T. unguicula* but is generally a little smaller and flatter, with the outline more triangular. The spiculation is sufficiently different in Blochmann's opinion to separate the species. The tropical distribution also reënforces the argument.

TEREBRATULINA HAWAIIENSIS, new species.

Shell ovate, white or slightly brownish, rather compressed, thin, closely radially finely threaded, the threads coarser and more distinctly granulated by incremental lines near the beaks; foramen in the pedicel valve large, the deltidial plates narrow, oblique, widely separated; peduncular collar strong, short, with free anterior edge, dental processes strong, without props; brachial valve with the dental plates rather widely separated, between them in the young a concave wide rugose cardinal process which in older shells becomes irregular in shape and relatively less prominent; the loop is slender and rather wide; the genital sinuses are profusely reticulated and cover the whole disk of the valve to within a very short distance of the margin. Length of shell, 19, width 15, diameter 8 mm. The Australian specimen measures, respectively, 26, 20, and 12 mm.

Type locality.—Hawaiian Islands, Bureau of Fisheries.

Cat. No.	Locality.	Collector.	Number of specimens.
274156	Type. Hawaiian Islands	B. F	1
211013	Port Adelaide, Australia	Sowerby	1

This species appears to be separated from its nearest relations by details of the cardinalia and especially by its densely reticulate genital sinuses which exhibit less bilateral symmetry and simplicity than in any other species known to me. Externally it seems most like *T. callinome* Dall, which has quite simple and regular reticulate

sinuses and much wider and shorter deltidial plates. *T. crossei* Davidson grows much larger, is less coarsely striated, and while its genital sinuses are minutely reticulated the two symmetrical groups are widely separated by a space free of sinuses.

TEREBRATULINA CROSSEI Davidson.

Terebratulina crossei DAVIDSON, Journ. de Conchyl., vol. 30, p. 106, pl. 7, fig. 1, 1882; Mon. Rec. Brach., vol. 1, p. 33, pl. 3, figs, 4, 5, 6, 1886.

Type locality.—Sagami Bay, Japan.

Cat. No.	Locality.	Collector.	Number of specimens.
110833	Enosima, Japan	Fisher	1
110832	Yokohama	F. Stearns	2
219900	Off Redondo, California, 60 fathoms	Dr. Tremper	1

On a bunch of coral rock hooked up by fishermen from 60 fathoms off Redondo, California, several brachiopods were attached which seemed to me different from the *Laqueus californicus* usually found there, and after my return to Washington, Dr. R. H. Tremper, the collector, generously donated one of them to the United States National Museum. It was a great surprise to find the Japanese species on our coast, but there seems no doubt about the identification of the shell. The dried animal showed the reflected part of the brachia comprising the median coil was not, as usual, united by a thin band of tissue but the right and left brachia appeared to be quite free from one another medially except at the posterior commissure; while in the nearest related species, *T. callinome,* a membrane exists between the two arms of the reflected loop and back over the shelly loop to the vicinity of the adductors. The spiculae were remarkably visible under a hand lens in beautiful stellate forms and profusely invading the tissues everywhere. The genital sinuses comprise two groups separated distinctly from one another by a space entirely free from sinuses and each group comprising about one half the space of its side of the valve, extending nearly to the anterior margin of the valve and composed of a multitude of small reticulations densely carpeted with spiculae. The species reported by Fischer and Oehlert from Magellan Straits, under this name, is said by Blochmann to be distinct.

TEREBRATULINA CALLINOME, new species.

Shell resembling *T. crossei* Davidson on a smaller scale, but more sharply sculptured, whitish or pale salmon-colored, glistening, the radial sculpture of sharp striae with flattish wider interspaces (not raised as in *T. japonica*); the foramen large, the deltidial plates small, not coalescent medially; brachial valve with slender brachia with rather short filaments, the reflected arms united by a membrane as

described under the last species, the loop narrow, compressed, rather long, with a strong median fold; genital sinuses about half as long as the valve, densely vermicular, broad behind, in front narrower with two or three lateral branches, the two series separated by at least half the width of the valve. Length of shell 31; width 24, diameter 19 mm.

Type locality.—Cebu, Philippine Islands, in 310 fathoms, U. S. Bureau of Fisheries.

Cat. No.	Locality.	Collector.	Number of specimens.
110814	Goto Islands, Japan, 181 fathoms	B. F	1
110816	Off Honshu Islands, Japan, 125 fathoms	B. F	1
110835	Off Yokohama, Japan	F. Stearns	1
110815	Kagoshima Gulf, 103 fathoms	B. F	2
273658	Kii, Japan	Hirasé	3
204677	Off Hondo, Japan, 448 fathoms	B. F	1
204674	Off Hondo, Japan, 302 fathoms	B. F	1
204678	Off Hondo, Japan, 88 fathoms	B. F	1
204676	Eastern Sea, Japan, 95 fathoms	B. F	1
229360	West of Sequijor, Philippine Islands, 254 fathoms.	B. F	2
238880	(Types) Cebu, Philippine Islands, 310 fathoms.	B. F	40
295908	West of Luzon, Philippine Islands, 170 fathoms.	B. F	2½
296272	West of Luzon, Philippine Islands, 198 fathoms.	B. F	2 v.
294638	Off Jolo, Philippine Islands, 161 fathoms	B. F	Many yo.
237994	Off Balabac, Philippine Islands, 68 fathoms	B. F	1
238828	Mindanao, Philippine Islands, 182 fathoms	B. F	3
220094	Mindanao, Philippine Islands, 162 fathoms	B. F	1
295322	Off Mindanao, Philippine Islands, 100 fathoms.	B. F	1 v.
298968	Off Mindanao, Philippine Islands, 219 fathoms.	B. F	1 v.
299276	Off Simaluc, Philippine Islands, 340 fathoms.	B. F	1
294715	Off North Burias, Philippine Islands, 105 fathoms.	B. F	9
299748	Off Sipadan, Borneo, 347 fathoms	B. F	3

There is no perceptible folding of the valves in any of the specimens. This species has been received with the label "*T. japonica*" and it is likely that young specimens have been confused with that species which is of the *retusa* type, while the present species leans toward *T. crossei.*

The reception of abundant material gives an opportunity for discrimination between similar species which can not be afforded by a few specimens.

TEREBRATULINA JAPONICA Sowerby.

Terebratula japonica Sowerby, Proc. Zool. Soc., 1846, p. 91; Thes. Conch., vol. 1, p. 344, pl. 68, figs. 7, 8, 1847. (Not of Adams and Reeve, 1850).—Reeve, Conch. Icon., *Terebratula*, pl. 4 figs. 15c, 16, 1860.

Terebratula angusta Adams and Reeve, Voy, Samarang, Zool. Moll. p. 71, pl. 21, fig. 2, 1850.—Reeve, Conch. Icon., *Terebratula*, pl. 4, fig. 16, 1860.

Terebratulina japonica Dall, Proc. Acad. Nat. Sci. Phila., for 1873, p. 180 (*Syn. excl. ex parte*).—Davidson, Mon. Rec. Brach., pt. 1, p. 34, pl. 3, figs. 7–11, 1886.

Terebratulina caput-serpentis Davidson, Proc. Zool. Soc. 1871, p. 303, pl. 30, fig. 8.

Cat. No.	Locality.	Collector.	Number of specimens.
110817	Korea Strait, 59 fathoms	B. F	1
204687	Korea Strait, 59 fathoms	B. F	1
110818	Korea Strait, 59 fathoms	B. F	4
110819	Korea Strait, 59 fathoms	B. F	2
206800	Suruga Gulf, Japan, 108 fathoms	B. F	2
278157	Japan Sea, 44 fathoms	B. F	20 yo.
110820	Eastern Sea, 106 fathoms	B. F	1
110821	Goto Islands, Japan, 95 fathoms	B. F	1
110822	Honshu Islands, Japan, 75 fathoms	B. F	1
110838	Sunosaki, Japan, 49 fathoms	B. F	1
110839	Honshu Islands, Japan, 65 fathoms	B. F	3
193633	Honshu Islands, Japan, 55 fathoms	B. F	1
110840	Japan	Fisher	1
278158	Hakodate, Japan	E. S. Morse	12 yo.
278159	Yenoshima, Japan	E. S. Morse	1

The above are typical and I feel no doubt of the identity of *japonica* Sowerby and *angusta* Adams. I think this shell was more or less confused with *T. callinome* by Davidson and others, doubtless from want of sufficient material for comparison. The valves show no sign of folding or bilobation.

TEREBRATULINA REEVEI, new species.

The following material I believe to belong to *T. japonica* Adams and Reeve (fig. 1, 1850) not Sowerby. I am uncertain whether it should be regarded as a distinct species or not, though from the entire absence of large specimens, such as occur in Japan, I am inclined to believe in its distinctness. It differs from the young specimens of *T. japonica* Sowerby by its tendency to bilobation, and in a general way by its usually coarser sculpture, its coarsely crenulated inner margin, the loop with the lower medial portion projected as a sharp point while in *japonica* Sowerby it is squarely truncated in front. The brachia are like those in *T. retusa*, the genital sinuses reticulated, adjacent, and occupying the middle half of the shell with no distinct branches, and with a covering of elegantly stellate spiculae, easily visible under a hand lens. An average specimen measures 8 mm. long by 6.5 wide, and about 3 mm. in diameter, the largest about 15 mm. in length. Under the circumstances I propose to give it the provisional name of *reevei*.

Type locality.—Near Lubang, Philippines, in 117 fathoms, at station 5279.

Cat. No.	Locality.	Collector.	Number of specimens.
111064	Off Luzon, Philippine Islands, 105 fathoms	B. F	2
295621	Off Mindoro, Philippine Islands, 244 fathoms.	B. F	1½
292380	Off Tablas, Philippine Islands, 73 fathoms	B. F	7
297576	Off Balabac, Philippine Islands, 68 fathoms	B. F	15
297487	Palawan Pass, Philippine Islands, 375 fathoms.	B. F	2
299038	Sulu Islands, Philippine Islands, 243 fathoms.	B. F	1½
298770	Off South Negros, Philippine Islands, 254 fathoms.	B. F	6
237378	Davao, Gulf, Philippine Islands, 100 fathoms.	B. F	1
298312	Northwest Leyte, Philippine Islands, 144 fathoms.	B. F	15
291278	Northwest Leyte, Philippine Islands, 114 fathoms.	B. F	1
299342	Tawitawi, Philippine Islands, 340 fathoms	B. F	5
299323	Tawitawi, Philippine Islands, 340 fathoms	B. F	1½
299322	Tawitawi, Philippine Islands, 340 fathoms	B. F	1
299226	Tawitawi, Philippine Islands, 340 fathoms	B. F	3
292225	Tawitawi, Philippine Islands, 230 fathoms	B. F	6
292924	Tawitawi, Philippine Islands, 49 fathoms	B. F	4
292095	Tawitawi, Philippine Islands, 49 fathoms	B. F	1
111065	Tawitawi, Philippine Islands, 230 fathoms	B. F	1
292107	North Cebu, Philippine Islands, 182 fathoms.	B. F	1
295319	Mindanao, Philippine Islands, 100 fathoms	B. F	1
238830	Mindanao, Philippine Islands, 182 fathoms	B. F	1
238824	Mindanao, Philippine Islands, 182 fathoms	B. F	2
237545	(Types) Lubang, Philippine Islands, 117 fathoms.	B. F	8
237540	Lubang, Philippine Islands, 117 fathoms	B. F	2
230242	Off Jolo, Philippine Islands, 20 fathoms	B. F	1
240075	Manila Bay, Philippine Islands, 10–20 fathoms.	B. F	1
294380	Manila Bay, Philippine Islands, 135 fathoms	B. F	6
230126	Off Point Talin, Philippine Islands, 201 fathoms.	B. F	1
230055	Off Point Talin, Philippine Islands, 248 fathoms.	B. F	1 v.
295830	Off West Luzon, Philippine Islands, 170 fathoms.	B. F	1½
295776	Off West Luzon, Philippine Islands, 220 fathoms.	B. F	1
295454	Off West Luzon, Philippine Islands, 214 fathoms.	B. F	1
295950	Off West Luzon, Philippine Islands, 170 fathoms.	B. F	1
296220	Off West Luzon, Philippine Islands, 210 fathoms.	B. F	2
229537	Off Mindoro, Philippine Islands, 162 fathoms.	B. F	2 v.
294677	Off North Burias, Philippine Islands, 105 fathoms.	B. F	Many.
246324	Off North Burias, Philippine Islands, 105 fathoms.	B. F	2
294666	Off North Burias, Philippine Islands, 105 fathoms.	B. F	8
294922	Marinduque, Philippine Islands, 530 fathoms.	B. F	1
300494	Off East Cebu, Philippine Islands, 159 fathoms.	B. F	1
291161	Sibuku Bay, Borneo, 292 fathoms	B. F	1 v.
291166	Sibuku Bay, Borneo, 292 fathoms	B. F	6
290954	Sibuku Bay, Borneo, 347 fathoms	B. F	3
299905	Silungan Island, Borneo, 305 fathoms	B. F	2½
291223	Off Sibutu Island, Borneo, 175 fathoms	B. F	1 v.
299570	Off Sibutu Island, Borneo, 175 fathoms	B. F	1 v.
299670	Off Sibutu Island, Borneo, 292 fathoms	B. F	3

TEREBRATULINA ABYSSICOLA Adams and Reeve.

Terebratula abyssicola ADAMS and REEVE, Voy. Samarang, Moll., p. 72, pl. 21, fig. 5, 1850.—REEVE, Conch. Icon. *Terebratula*, pl. 4, fig. 14.

Terebratulina abyssicola DAVIDSON, Mon. Rec. Brach., pt. 1, p. 37, pl. 5, fig. 54, 1886.

Terebratula radiata REEVE, Conch. Icon. *Terebratula*, pl. 3, figs. 7a–b, 1860.

Terebratulina radiata DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 180.—DAVIDSON, Mon. Rec. Brach., pt. 1, p. 34, pl. 6, figs. 9–14, 1886.

Type locality.—Cape of Good Hope, 120 fathoms, Sir E. Belcher.

Cat. No.	Locality.	Collector.	Number of specimens.
110439	Off Cape of Good Hope	Belcher	1
127017	Port Elizabeth, South Africa	Rolle	7
110438	Aguthas Bank	Blochmann	3
110841	Cape of Good Hope	Sowerby	3
110842	Cape of Good Hope, 120 fathoms	Belcher	1

Number 110842 is a cotype of *T. radiata* from Belcher's collection through Gwyn Jeffreys. Reeve's reference to Korea is an error of memory. The two forms are identical.

TEREBRATULINA KIIENSIS Dall and Pilsbry.

Terebratulina kiiensis DALL and PILSBRY, Nautilus, vol. 5, No. 2, June, 1891, p. 18, pl. 1, figs. 4, 5; Proc. U. S. Nat. Mus., vol. 17, 1894, p. 720, pl. 32, figs. 8, 9.—PILSBRY, Moll. Brach. of Japan, Mar., 1891, p. 152, pl. 11, figs. 9, 10.

Type locality.—Coast of the Province of Kii, Japan. F. Stearns.

Cat. No.	Locality.	Collector.	Number of specimens.
128463	Kii Province, Japan (cotype)	F. Stearns	1
226205	Japan Sea, 265 fathoms	B. F	2
274160	Yenoshima	Morse	2
110837	Off Honshu Island, 265 fathoms	B. F	1
110825	Off Honshu Island, 70 fathoms	B. F	1
123151	Unalaska, Alaska, 309 fathoms	B. F	$1\frac{1}{2}$
110336	Coast of Washington, 559 fathoms	B. F	2
123153	Santa Cruz, California, 240 fathoms	B. F	1
123154	Santa Cruz, California, 240 fathoms	B. F	4
208868	San Nicolas Island, California, 451 fathoms	B. F	1

It has been a great surprise to find this fine species described from Japan inhabiting the deep water of the Pacific coast, together with the presence of *T. crossei* Davidson, and the remarkable *Terebratula sakhalinensis* Dall. The large size and rotund disk-like form differentiate it from any of the other species of the genus.

TEREBRATULINA CANCELLATA Koch.

Terebratula cancellata KOCH, in Küster, Conch. Cab., ed. 2, *Terebratula*, p. 35, pl. 2b, figs. 11, 12, 13, 1848.—SOWERBY, Thes. Conch., vol. 1, p. 358, pl. 71, figs. 93–95, 1847.—REEVE, Conch. Icon. *Terebratula*, pl. 4, fig. 13, 1860.

Terebratulina cancellata DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 179.—DAVIDSON, Mon. Rec. Brach., pt. 1, p. 35, pl. 6, figs. 1–8, 1886.

Type locality.—Western Australia.

Cat. No.	Locality.	Collector.	Number of specimens.
110834	South Australia	Sowerby	1
332788	South Australia	Fulton	4

TEREBRATULINA CAVATA Verco.

Terebratulina cavata VERCO, Trans. Royal Soc. of South Australia, vol. 34, p. 95, pl. 28, figs. 1–5, 1910.

Type locality.—Off Cape Jaffa, South Australia, in 130 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
214308	Off Cape Jaffa, 130 fathoms	Verco	2

TEREBRATULINA CAILLETI Crosse.

Terebratulina cailleti CROSSE, J. de Conchyl., vol. 13, p. 27, pl. 1, figs. 1, 2, 3, 1865.—DALL, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 10, 1871.—DAVIDSON, Mon. Rec. Brach., pt. 1, p. 26, pl. 5, figs. 41, 42, 1886.

Type locality.—On the lee side of Guadeloupe Island, West Indies, in about 100 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
214441?	Grand Banks	Clarke	1 yo.
108251	Off Georgia, 449 fathoms	B. F.	12
108215	Off Fernandina, 294 fathoms	B. F.	20
107526	Florida Keys, 200 fathoms	Nutting	1
274161	Off Sand Key, 115 fathoms	Henderson	8
274162	Off Sambo Reef, 120 fathoms	Henderson	Many.
64240	Tortugas, 101 fathoms	U. S. S. *Blake*	1
64241	Tortugas, 539 fathoms	U. S. S. *Blake*	3
110889	Chorrera, Cuba, 230 fathoms	U. S. S. *Blake*	3
63239	Off Havana, Cuba, 450 fathoms	Sigsbee	9
93825	Off Havana, Cuba, 201 fathoms	B. F.	1
94075	Off Havana, Cuba, 114 fathoms	B. F.	1
64238	Off Havana, Cuba, 400 fathoms	U. S. S. *Blake*	1
94082	Yucatan Bank, 399 fathoms	B. F.	1
226293	Mayaguez, Porto Rico., 224 fathoms	B. F.	1
64243	Dominica, 18 fathoms	U. S. S. *Blake*	1

Cat. No.	Locality.	Collector.	Number of specimens.
64244	Sta. Lucia, 164 fathoms	U. S. S. *Blake*	3
64242	Grenadines, 127 fathoms	U. S. S. *Blake*	1
64237	Barbados, 69 fathoms	U. S. S. *Blake*	25
314854	Barbados, 80 fathoms	Henderson	35
314853	Barbados	Henderson	25
314852	Barbados, 60–70 fathoms	Henderson	25
314851	Barbados, 45–75 fathoms	Henderson	6
314850	Barbados, 80 fathoms	Henderson	20
314849	Barbados, 70–80 fathoms	Henderson	Many.
314848	Barbados, 50–60 fathoms	Henderson	20
314847	Barbados, 80 fathoms	Henderson	Many.
314846	Barbados	Henderson	18
314845	Barbados, 75 fathoms	Henderson	22
314858	Barbados, 60 fathoms	Henderson	1
314857	Barbados, 75–80 fathoms	Henderson	12
314856	Barbados, 35–75 fathoms	Henderson	2
314859	Barbados, 30–70 fathoms	Henderson	1
314860	Barbados, 25–72 fathoms	Henderson	19
314861	Barbados, 40 fathoms	Henderson	14
314862	Barbados, 50–60 fathoms	Henderson	4

TEREBRATULINA CAILLETI, new variety LATIFRONS.

The valves wider, more or less bilobate, white outside, salmon tinted inside.

Type locality.—Off Barbados in 35 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
314855	Barbados, station 24, 35 fathoms	Henderson	3
95542	Off Tobago, 880 fathoms	B. F	3
226293	Mayaguez Harbor, 224 fathoms	B. F	1

The normal *cailleti* is usually white, but frequently of a reddish color. It is the most abundant West Indian species. It is possible that the young individual from the Grand Banks may be the immature form of another species.

TEREBRATULINA PHOTINA, new species.

Shell small, ovate, white, rather compressed, showing no indications of a fold anteriorly; surface smooth, only showing fine radial striae under a lens; punctation dense and conspicuous; pedicel valve with a small short rather pointed beak, a wide incomplete foramen and small deltidial plates; hinge teeth small, rather adjacent, not propped; there are three faint radial furrows in the depth of the valve but no septum; the pedicel "collar" is short and strong, with a free edge; brachial valve subcircular, with narrow cardinalia and a squarish hingeplate with a small concave medial process; loop long, narrow,

complete, the lower portion produced into a conspicuous point medially. Length of shell 15; width 12; diameter 5.5 mm.

Type locality.—U. S. Bureau of Fisheries, station 5586, in 347 fathoms, mud, bottom temperature 44° F., in Sibuku Bay, Borneo, off Sipadan Island.

Cat. No.	Locality.	Collector.	Number of specimens.
299274	Tawitawi Islands., Philippine Islands., 340 fathoms	B. F.	1
299346	Tawitawi Islands., Philippine Islands., 340 fathoms	B. F.	1½
300278	Celebes, 540 fathoms	B. F.	1 v.
291010*a*	Celebes, 540 fathoms	B. F.	1
299741	Borneo (types), 347 fathoms	B. F.	3

If it were not for the complete loop this species would certainly be taken for a *Gryphus*. The striation is so fine and faint that it is invisible without magnification. With the cardinalia complete it can not be mistaken for any other species of *Terebratulina*.

TEREBRATULINA RADULA Hedley.

Terebratulina radula Hedley, Proc. Linn. Soc. N. S. W., vol. 29, p. 209, pl. 10, figs. 48–50, 1904.

Type locality.—East of Wollongong, Australia, in 100 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
335706	Off Narrabeen, New South Wales, 80 fathoms.	Hedley	7

Genus GRYPHUS Megerle von Mühlfeldt.

Gryphus Megerle, Mag. d. Ges. Naturf. freunde zu Berlin, 5ter Jahrg., 1811, p. 64.—Dall., Bull. U. S. Nat. Mus. No. 8, p. 70, 1877. Not *Gryphus auctorum* as of Brisson, 1760, in error. Not *Gryphus* Oken, 1816.

Terebratula Lamarck, Hist. Anim. s. Vert., vol. 6, pt. 1, p. 245, 1819.

Liothyris Douvillé, Bull. Soc. Géol. de France, sér. 3, vol. 7, p. 265, 1879; not of Conrad, Geol. Rep. N. Carolina, App. p. 9, 1873.

Liothyrina Oehlert in Fischer, Man. de Conchyl., p. 1316, 1887.

Type.—*Anomia vitrea* Born.

The name *Gryphus* Megerle has been rejected by authors on the ground that it was preoccupied by an alleged genus *Gryphus* of Brisson in his work on birds. This, however, is due to an error. Brisson described no genus *Gryphus* but used the word as a *specific* name for the Condor, one of the species of his genus *Vultur* (p. 28). Hence the brachiopod name is not, in a generic sense, preoccupied by its occurrence (p. 473) in Brisson's Ornithologia. The name has been used by

several authors in a generic sense later, but except in the case of the Museum Calonnianum, all are subsequent to Megerle. The Museum Calonnianum has been rejected as a source of valid nomenclature by the International Committee on Nomenclature, but in any case it did not originally contain the name *Gryphus* which at some later date was written in as a substitution for *Lacinia* in some copies. There is no way of determining the date of this manuscript emendation, which in any case could not be accepted, since the circulation of a manuscript does not constitute publication.

GRYPHUS VITREUS Born.

Anomia seu Terebratula minorica Herbigny, Dict. Hist. Nat., vol. 1, p. 80, 1775; (not a binomial work.)

Anomia vitrea Born, Index Mus. Vind., p. 106, 1778; Test. Mus. Vind., p. 119, 1780.—Gmelin, Syst. Nat., vol. 4, p. 3347, 1792.

Terebratula vitrea Lamarck, Système, p. 139, 1801, Anim. s. Vert., vol. 6, pt. 1, p. 245, 1819.

Gryphus vitreus Megerle, Mag. d. Ges. Naturf. freunde zu Berlin, 5ter Jahrg., 1811, p. 64.

Liothyris vitrea Douvillé, Bull. Soc. Géol. de France, sér. 3, vol. 7, p. 265, fig. 6, 1879.—Davidson, Mon. Rec. Brach., pt. 1, p. 6, pl. 1, figs. 1–12, 1886.

Liothyrina vitrea Oehlert, in Fischer, Man. de Conchyl., p. 1316, fig, 1104, 1887.

Terebratula (*Liothyrina*) *vitrea* Fischer and Oehlert, Expl. du *Travailleur* et du *Talisman*, p. 51, pl. 3, figs. 7 *a–b*, 1891.

Type locality.—Port Mahon, Island of Minorca, Mediterranean Sea.

Cat. No.	Locality.	Collector.	Number of specimens.
109745	Mediterranean	Ital. Exp	1
32926	Naples	Dr. Newberry	1
110849	Mediterranean	Dall	1
11884	Mediterranean	Damon	2
17816	Mediterranean	Jeffreys	2
6804	Mediterranean	Jeffreys	1
21949	Mediterranean	Crosse	1
274163	Mediterranean	S. Smith	1
109740	Mediterranean	Issel	1
109791	Bay of Naples	Dohrn	8
109734	Bay of Naples	Tiberi	5
109725	Adventure Bank, 92 fathoms	*Porcupine* Exp	2
109726	Adventure Bank, 120 fathoms	*Shearwater* Exp	3
109727	Algerine coast, 1,456 fathoms	*Porcupine* Exp	3
109724	Morocco coast, 207 fathoms	*Porcupine* Exp	6
109728	Corsica	Susini	1
109730	Sardinia	Tiberi	4
109770	Sardinia	Tiberi	3
109731	Sardinia	Tiberi	8
109732	South of Sicily, 266 fathoms	*Porcupine* Exp	6
109735	Pantellaria, 40 fathoms	Capt. Nares	1
109736	Tunis, 100 fathoms	Capt. Nares	1
109738	Benzert Roads, Tunis, 50 fathoms	Carpenter	15
109739	Benzert Roads, Tunis, 310 fathoms	Capt. Spratt	Fr.
109729	Mediterranean	Italian Exp	1
109741	Station 22, 200 fathoms	Italian Exp	1
109742	Station 22, 400 fathoms	Italian Exp	1

Cat. No.	Locality.	Collector.	Number of specimens.
109743	Station 21, 800 fathoms	Italian Exp	1
109744	Station II	Italian Exp	1
109711	West of Portugal, 220 fathoms	*Porcupine* Exp	1
109712	West of Portugal, 994 fathoms	*Porcupine* Exp	1
109713	West of Portugal, 1,095 fathoms	*Porcupine* Exp	3
109715	South of Portugal, 292 fathoms	*Porcupine* Exp	10
130334	Gulf of Cadiz, 224 fathoms	*Travailleur*	4 Fr.
109717	South of Portugal, 364 fathoms	*Porcupine* Exp	15
109716	West of Portugal, 374 fathoms	*Porcupine* Exp	1
109718	South of Portugal, 322 fathoms	*Porcupine* Exp	5
109719	Off Southwest Spain, 304 fathoms	*Porcupine* Exp	3
109720	Off Southwest Spain	*Porcupine* Exp	Fr.
109721	Off Southwest Spain, 227 fathoms	*Porcupine* Exp	1
109722	Capo de Gata, 69 fathoms	*Porcupine* Exp	1
109723	Off Cape Sagres	*Porcupine* Exp	1

GRYPHUS VITREUS var. ELONGATUS Jeffreys.

109755	Sardinia	Tiberi	2
109743	Sardinia	Tiberi	2

GRYPHUS VITREUS var. DILATATUS Jeffreys.

109756	Sardinia	Tiberi	4
109769	Sardinia	Tiberi	3

The two varities above mentioned certainly differ enough from the normal shell to receive varietal names. It is curious that both should have come from Sardinia. The *elongatus* is narrow almost subcylindrical, and as there are four specimens of it, it can hardly be regarded as a deformity. The other variety, *dilatatus*, is lenticular, subcircular and much less inflated than the normal *vitreus*. If found in another faunal area one could hardly hesitate to regard it as a new or at least a distinct species. Except in form they do not appear to differ from normal *vitreus*. The varietal names used above were attached to the specimens by Jeffreys, but I have not found that they have been published.

GRYPHUS AFFINIS Calcara.

Terebratula vitrea var. *minor* PHILIPPI, En. Moll. Sicil., vol. 1, p. 99, pl. 6, fig. 8, 1836.

Terebratula minor SUESS, Wohns. d. Brach. 1859, not of Nilsson, Petr. Suecica, 1827.

Terebratula affinis CALCARA, Cenno Moll. viv. e foss. di Sicilia, p. 48, 1845.—SEGUENZA, Sulla form, Mioc. di Sicilia, p. 7, 1862.

Terebratula vitrea var. *minor* DAVIDSON, Mon. Rec. Brach., pt. 1, p. 9, pl. 1, fig. 13, 1886.

Liothyrina affinis BLOCHMANN, Zeitschr. f. Wiss. Zool., vol. 90, p. 605, text fig. 1, pl. 36, fig. 8, 1908.

Type locality.—Lipari Islands, Mediterranean.

Cat. No.	Locality.	Collector.	Number of specimens.
110850	Mediterranean	Davidson	1
109750	Lipari Ids	Tiberi	10
109752	Gulf of Naples	Tiberi	1
109753	Gulf of Naples	Acton	1
109758	Gulf of Naples	Tiberi	7
109760	Gulf of Naples, 72 fathoms	Acton	6
109762	Gulf of Naples (young)	Tiberi	1
109749	Sardinia	Tiberi	6
109754	Adriatic	Stossich	2
109764	Sicily	Benoit	2
109757	Adventure Bank	Carpenter	1
109759	Adventure Bank, 130 fathoms	Carpenter	35
109765	Skerke Bank, 120 fathoms	Carpenter	7
109763	Benzert Roads, Tunis, 100 fathoms	Carpenter	10
109761	Villa Franca, Azores, 699 fathoms	*Josephine* Exp	1
108252	Off Georgia, 440 fathoms	B. F	2v.
108216	Off Fernandina, Fla., 294 fathoms	B. F	2v.

The distinctness of this species, which is also found in the Italian Tertiary, has been confirmed by Blochmann. The American specimens want the loop and are only tentatively placed here.

GRYPHUS JOLOENSIS, new species.

Shell rounded triangular, widest at the anterior third, smooth except for concentric lines of growth, not folded; beak high, incurved and conspicuous with a large entire foramen, the deltidial plates small and narrow, coalescent; hinge margin thickened, longer than the short stout teeth, anterior margin smooth, muscular impressions obscure; brachial valve less inflated, dental plates wide, the the sockets faintly cross striated, the loop short, rather wide, the lower portion with a median deep sulcus behind and a corresponding projection in front, the crura short and blunt; the plates are separated to the apex where there is a prominent callosity serving as cardinal process; the front edge of the valves is nearly straight. Height of pedicel valve 17, maximum breadth 14, diameter 7 mm.

Type locality.—United States Bureau of Fisheries station 5172, in 318 fathoms, off Jolo, Philippine Islands.

Cat. No.	Locality.	Collector.	Number of specimens.
111062	Off Jolo, 318 fathoms	B. F	2
111066	Off Tawitawi Ids., 230 fathoms	B. F	1
111063	Philippine Ids., 105 fathoms	B. F	1

Though without any very striking characters I can not unite this with any of the related species.

GRYPHUS BORNEOENSIS, new species.

Shell large, yellowish white, with tinges of brown, inflated, broadly and squarely folded anteriorly; apparently smooth but showing under a lens fine radial threads with wider interspaces and conspicuous, not very dense punctation; pedicel valve with a moderate entire foramen, the beak so strongly incurved as to hide entirely the narrow concave, coalescent deltidial plates, which in loose valves show more or less prominently four or more threadlike cross ridges mesially obsolete; there is a well marked "collar" inside the foramen; the muscular scars are well impressed; the brachial valve has wide concave crural plates well divided to the apex where there is a small but prominent cardinal process; the hinge teeth are small, the crura triangular and short, the loop short, widening forward, the lower part without a posterior sulcus, slightly medially ridged, angular and sharply pointed at the anterior corners, but with no medial projection, a short threadlike ridge divides the slightly impressed muscular scars; the anterior edge has a squarish not very deep indentation for the projection of the pedicel valve. Height of shell 41; width 33; diameter 25 mm. U. S. Nat. Mus. Cat. No. 229297.

Type locality.—South of Silungan Island, Sibuko Bay, Borneo, at Station 5592, in 305 fathoms, bottom temperature 43° 3 F.

Cat. No.	Locality.	Collector.	Number of specimens.
229297	Sibuko Bay, 305 fathoms	B. F.	1½
239287	Molucca Pass, 272 fathoms	B. F.	1v.
238396	Jolo Sea, 508 fathoms	B. F.	1v.

This species recalls *G. bartletti* Dall, but is wider and more rounded, with a wider and less emphatic fold, and there are small differences in the form of the loop. The young shell, judging by the incremental lines, is subcircular or even a little wider than high.

GRYPHUS BARTLETTII Dall.

Terebratula bartlettii DALL, Amer. Naturalist, vol. 16, p. 885, Nov., 1882; Bull. Mus. Comp. Zool., vol. 12, No. 6, pp. 200–201, pl. 6, fig. 4*a–c*, 1886.—DAVIDSON, Mon. Rec. Brach., pt. 1, p. 14, pl. 1, figs. 20-21. 1886.

Type locality.—Barbados, 73 fathoms, Captain Bartlett.

Cat. No.	Locality.	Collector.	Number of specimens.
110852	Barbados, 73 fathoms	Bartlett	1
64263	West Florida, 100 fathoms	*Blake*	1
103222	South of Cuba, 254 fathoms	B. F.	1
64257	Off Montserrat, 88 fathoms	*Blake*	5½
64259	Off Montserrat, 120 fathoms	*Blake*	1
64258	Off Grenada, 164 fathoms	*Blake*	2
64260	Off Grenada, 92 fathoms	*Blake*	1
64261	Off Grenada, 164 fathoms	*Blake*	1
64262	Off St. Kitts, 250 fathoms	*Blake*	1

A large number of other localities are recorded in my *Blake* Report above cited, which are represented by specimens in the Museum of Comparative Zoology at Harvard University. This species ranges in color from white to salmon-color.

GRYPHUS CUBENSIS Pourtales.

Terebratula cubensis POURTALES, Bull. Mus. Comp. Zool., vol. 1, No. 6, p. 109, Dec. 1867.—DALL, Mus. Comp. Zool., vol. 3, p. 3, pl. 1, figs. 2, 8–15, 1871.—DAVIDSON, *Challenger* Brach., p. 28, pl. 2, figs. 10, 11, 1880.

Terebratula vitrea var. *sphenoidea* JEFFREYS, Proc. Zool. Soc., 1878, p. 404, pl. 22, fig. 6 (*ex parte*) not of Philippi.

Lyothyris sphenoidea DAVIDSON, Mon. Rec. Brach., pt. 1, p. 12 (*ex parte*), pl. 2, figs. 19 *a–b*, 21, 22, 1886.

Type locality.—Off Havana, Cuba, in 270 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
109768	Gulf of Mexico	Pourtales	1
109747	Gulf of Mexico	Pourtales	2
109748	Gulf of Mexico	Pourtales	10
110854	Florida Strait, 400 fathoms	Stearns	11
107524	Florida Strait, 200 fathoms	Nutting	2
110856	Florida Strait	B. F.	9
110857	Florida Keys	B. F.	1
274164	Off Sambo reef, 120 fathoms	Henderson	6
274165	Off Sambo reef, 118 fathoms	Henderson	2
187238	Off Key West, 122 fathoms	B. F.	2
274167	Off Key West, 75 fathoms	Henderson	1
187237	Off Key West, 122 fathoms	B. F.	5
193545	Off Key West, 120 fathoms	B. F.	1
87351	Off Fernandina, 294 fathoms	B. F.	1
274166	Off Western dry reefs, 144 fathoms	Henderson	6
87378	Off Little Bahamas, 338 fathoms	B. F.	8
110855	Off Cuba, 2,690 fathoms	B. F.	1
64249	Off Havana, 400 fathoms	*Blake*	1
64248	Off Havana, 119 fathoms	*Blake*	10
193567	Off Havana, 279 fathoms	B. F.	1
211014	Off Havana, 387 fathoms	B. F.	1
226290	Mayaguez, Porto Rico, 224 fathoms	B. F.	15
64264	Off Guadeloupe, 175 fathoms	*Blake*	1
64251	Off St. Vincent, 88 fathoms	*Blake*	2
64250	Off Montserrat, 88 fathoms	*Blake*	1

The specific distinction of this species from *G. vitreus, sphenoideus*, and others, which I affirmed in 1871, has been amply confirmed by the researches on its spiculation by Doctor Blochmann.

GRYPHUS SUBQUADRATUS Jeffreys.

Terebratula subquadrata JEFFREYS, Proc. Zool. Soc., 1878, p. 402, pl. 22, fig. 3.
Liothyris subquadrata DAVIDSON, Mon. Rec. Brach., pt. 1, p. 14, pl. 2, figs. 15, 16, 1886.

Type locality.—Off the Setubal coast of Portugal near the mouth of the Tagus River, in 500 to 600 fathoms; Saville Kent.

Cat. No.	Locality.	Collector.	Number of specimens.
130336	Off Setubal, 5–600 fathoms	S. Kent	1
130337	Off Setubal, 5–600 fathoms	Davidson	2
130338	Bay of Biscay	*Travailleur*	1

Remarkable for its widely spaced, minute, but sharp radiating threads.

GRYPHUS SPHENOIDEUS Philippi.

Terebratula sphenoidea PHILIPPI, En. Moll. Sicil., vol. 2. p. 67, pl. 18, fig. 6, 1844.
Terebratula vitrea var. *sphenoidea* JEFFREYS (*ex parte*) Proc. Zool. Soc., 1878, p. 404, pl. 22, fig. 6.
Lyothyris sphenoidea DAVIDSON, Mon. Rec. Brach., pt. 1, p. 12, pl. 2, figs. 17, 18 (only) 1886. (*L. cubensis* synonyms excluded).

Type locality.—For the original fossil; Pliocene of Lamanto, Calabria, Italy. For the recent shell; west of Portugal in 374 fathoms, *Porcupine* Expedition.

Cat. No.	Locality.	Collector.	Number of specimens.
109701	West of Portugal, 274 fathoms	*Porcupine* Exp.	3
109700	West of Portugal, 292 fathoms	*Porcupine* Exp.	1½
109699	Bay of Biscay, 277 fathoms	*Travailleur*	1
130235	Bay of Biscay, 277 fathoms	*Travailleur*	2
109767	Josephine Bank, 200 fathoms	Italian Exp.	1

No. 109700 exhibits a few microscopic threads laterally, resembling those of *G. subquadratus*. I do not feel altogether satisfied that the recent specimens collected by Jeffreys are identical with the Pliocene fossils although they are certainly quite similar. The latter average larger and more inflated and have a much thicker and more solid shell, judging by a large series received from Seguenza.

GRYPHUS ARCTICUS Friele.

Terebratula arctica Friele, Nyt. Magazin for Naturvidenskaberne, 1877 (Separate copies, p. 1) pl. 1, figs. 1 *a-c*.
Liothyrina arctica Davidson, Mon. Rec., Brach., pt. 1, p. 10, pl. 1, figs. 17, 18, 1886.

Type locality.—Station 237 of the Norwegian North Atlantic expedition. Southwest of Jan Mayen Island in 263 fathoms, bottom temperature 33° F.

Cat. No.	Locality.	Collector.	Number of specimens.
109798	Off Jan Mayen, 263 fathoms	Friele	2
202602	Off southeast Greenland, 108 fathoms	Wallich	1

GRYPHUS ANTARCTICUS Blochmann.

Liothyrina antarctica Blochmann, Zool. Anz., vol. 30, 1906, pp. 692-699, fig. 3; Zeitschr. f. wiss. Zool., vol. 90, 1908, p. 614.—Eichler, Brach. Deutsche Sud Polar Exped. Zool., vol. 4, p. 89, pl. 42, figs. 1–4; pl. 43, figs. 13, 19, 20; pl. 44, figs. 25-34, 1911.
Liothyrella antarctica Jackson, Brit. Antarctic Exp. Brachiopoda, p. 103, 1918.—Thomson, Austral. Antarctic Exp. Zool., vol. 4, pt. 3, p. 16, pl. 15, figs. 8, 9; pl. 18, figs. 65, 66, 1918.

Type locality.—Near the wintering station of the Gauss party, Kaiser Wilhelm's Land in 209 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
110441	Kaiser Wilhelm's Land, 209 fathoms	Gauss Exp	1

Owing to the extreme inconstancy in the same species among specimens from the same locality of the so-called dorsal septum in these Terebratulas I hesitate to assign this feature any systematic value. None of my specimens of *G. uva* show it except as a thickening so trifling that it does not interrupt the passage over it of the point of a pin.

GRYPHUS FULVA, Blochmann.

Terebratula uva (ex parte) Davidson, *Challenger* Brach., pp. 31–2, pl. 2, figs. 3–4, 1880; not of Broderip.
Liothyrina fulva Blochmann, Zool. Anz., vol. 30, p. 698, 1906; Zeitschr. f. Wiss. Zool., vol. 90, p. 617, pl. 38, fig. 22*a–b*; pl. 39, fig. 26, 1908; Proc. Roy. Soc. Tasmania for 1913, p. 112, pl. 10, figs. 1–6; pl. 12, figs. 12*a–b*, 1914.
Liothyrella fulva Allan Thomson, Brach. Austr. Antarctic Exp., p. 14, pl. 15, figs. 20–22; pl. 17, fig. 53, 1918.

Type locality.—Twofold Bay, Tasmania, 600 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
335703	Cabo Island, New South Wales, 115 fathoms	Hedley	2
333011	Off Cape Everard, 90–150 fathoms	Hedley	3

GRYPHUS UVA Broderip.

Terebratula uva BRODERIP, Proc. Zool. Soc. 1833, p. 124; Trans. Zool. Soc. Lond., vol. 1, p. 142, pl. 22, fig. 2, 1833.—SOWERBY, Thesaurus, vol. 1, p. 353, pl. 70, figs. 53-55, 1847.—REEVE, Conch. Icon., *Terebratula*, pl. 3, fig. 11, 1860.
Liothyrina uva DALL, Bull. Mus. Comp. Zool., vol. 43, No. 6, p. 443, 1908.

Type locality.—Gulf of Tehuantepec, in 10–12 fathoms, sandy bottom. Captain Dare.

Cat. No.	Locality.	Collector.	Number of specimens.
110851	Guayaquil	Martens	1
223628	Gulf of Panama, 1,175 fathoms	B. F	1

The specimen from deep water was dead and contained mud, when dredged. The true *G. uva* is a shallow water species. I have seen none from south of Peru. I strongly suspect that more than one species is involved in Davidson's discussion of *T. uva* both in the *Challenger* report and his monograph.

The genital sinuses in *G. uva* are reticulate and occupy the middle third of the valve with a vacant space mesially. The "septum" in the dorsal valve, in the specimens I have been able to examine, is extremely feeble, and often absent altogether. Something of the kind may be found in some specimens of almost any Terebratuloid, as for instance *G. vitreus*.

GRYPHUS MOSELEYI Davidson.

Terebratula moseleyi DAVIDSON, Proc. Roy. Soc., vol. 27, p. 436, 1878; *Challenger* Brach., p. 30, pl. 2, figs. 12-14, 1880.
Liothyris moseleyi DAVIDSON, Mon. Rec., pt. 1, p. 11, pl. 2, figs. 1–4, 1886.
Liothyrina moseleyi DALL, Bull. Mus. Comp. Zool., pt. 43, No. 6, p. 443, 1908.

Type locality.—West of Kerguelen Island, at a depth of 210 fathoms, *Challenger* Expedition.

Cat. No.	Locality.	Collector.	Number of specimens.
110853	Off New Jersey, 1,362 fathoms	B. F	1
64255	Off Martinique, 169 fathoms	*Blake*	1
110887	Gulf of Panama, 134 fathoms	B. F	7 v.

No. 64255 was submitted to Mr. Davidson and pronounced to be his *T. moseleyi*, agreeing very closely with his figures in the *Challenger* report. The other specimens appear to be conspecific, though the Panama specimens are dead and dilapidated valves. The older specimens show three marked short grooves separated by the muscular impressions which are more or less raised, in the pedicel valve, and in senile specimens these are quite deep.

There has been some doubt expressed as to the identity of the above specimens with the species dredged at Kerguelen, notwithstanding their agreement in the external features. I confess to some doubt myself and would suggest for the species in case they prove distinct the name of *Gryphus martinicensis*, the specimen numbered 64255 being taken as type.

GRYPHUS TOKIONIS, new species.

Terebratula? DAVIDSON, Proc. Zool. Soc., 1871, p. 312, pl. 31, fig. 6.

Type locality.—U. S. Bureau of Fisheries station 3661, in the Gulf of Tokio, Japan, in 169 fathoms, mud, bottom temperature 48° F.

Cat. No.	Locality.	Collector.	Number of specimens.
107731	Gulf of Tokio, 169 fathoms	B. F.	1
204669	Off Hondo Island, 302 fathoms	B. F.	1

The brachial valve is subcircular, the loop short, rather wide, the parts narrow, the lower portion slightly elevated mesially, the anterior corners angular and sharply pointed, the crura short and blunt, the plates deeply excavated, completely separated with a small prominent rugose cardinal process. There is a faint ridge between the muscular impressions, in the brachial valve, and another in the pedicel valve. The exterior is smooth, the foramen entire, there is a well marked "collar" within the foramen.

Mr. Davidson had a specimen of this species which he figured in his paper on Japanese brachiopods above cited. He did not describe it because the cardinalia were defective and he was doubtful about the genus. I have seen no subsequent reference to it.

GRYPHUS DAVIDSONI A. Adams.

Terebratula davidsoni A. ADAMS, Proc. Zool. Soc., 1867, p. 314, pl. 19, fig. 30.

Terebratula minor Davidson, Proc, Zool. Soc., 1871, p. 302, pl. 30, fig. 10; not of Philippi, 1836.

Liothyris vitrea var. *davidsoni*, DAVIDSON, Mon. Rec. Brach., pt. 1, p. 9, pl. 1, figs. 14–16, 1886.

Type locality.—Satanomosaki, Japan, 55 fathoms. A. Adams.

Cat. No.	Locality.	Collector.	Number of specimens.
110789	Korea Strait, 59 fathoms	B. F	1
110790	Korea Strait, 59 fathoms	B. F	1
110791	Kagoshima Gulf, Japan, 103 fathoms	B. F	1

This little species occupies a position in relation to the other brachiopods in the Japanese fauna analogous to that of *Gryphus minor* Philippi (*G. affinis* Calcara) in the Mediterranean fauna, but there seems to be no basis, except a general superficial similarity, for regarding them as identical.

GRYPHUS TRANSLUCIDUS, new species.

Shell small, white, smooth, polished, subtransparent, rounded triangular, moderately inflated; pedicel valve with a short beak, entire foramen, the deltidial plates narrow, coalescent, with a median suture; hinge teeth weak, close together; brachial valve less convex, the loop short, small, the anterior edge taken with the edges of the very short crura, describing two thirds of a circle, with no median ridge, sulcus or projecting point; crural plates separated to the apex with no trace of a cardinal process; two short shallow grooves in the valve below the loop separate the muscular impressions. Height 7.0, width 5.5, diameter 4.0 mm.

Type locality.—U. S. Bureau of Fisheries stations 5153, Tawitawi Islands, in 49 fathoms, sand, and 5236, off Nagubat Island, East Mindanao, Philippines, in 494 fathoms, sand, bottom temperature 41.2° F.

Cat. No.	Locality.	Collector.	Number of specimens.
294903	Off Nagubat Island, 494 fathoms	B. F	6
300660	Off Cagayan Island, 495 fathoms	B. F	2
291085	Off Dammi Island, Sulus, 243 fathoms	B. F	1v.
295780	Off East Mindanao, 171 fathoms	B. F	1
291227	Off Sibutu Island, Sulus, 175 fathoms	B. F	1v.
292374	Off Tablas Island, 73 fathoms	B. F	2v.
292931	Off Tawitawi Islands, 49 fathoms	B. F	1
299330	Off Tawitawi Islands, 340 fathoms	B. F	5
291160	Off Sibuko Bay, Borneo, 292 fathoms	B. F	1
291010	Gulf of Boni, Celebes, 540 fathoms	B. F	6
300318	Gulf of Boni, Celebes, 700 fathoms	B. F	1v.

This little species resembles no other yet described recent form and there is no indication that it reaches much greater dimensions than those given above. Notwithstanding the number of specimens none retained the brachia, No. 292931 alone had the space below the

loop covered by a densely spiculose membrane. The genital sinuses were imperceptible.

GRYPHUS WYVILLI Davidson.

Terebratula wyvilli DAVIDSON, Proc. Roy. Soc., vol. 27, p. 436, 1878.
Terebratula wyvillii DAVIDSON, *Challenger* Brach., p. 27, pl. 2, figs. 7–9, 1880.
Lyothyris wyvillii DAVIDSON, Mon. Rec. Brach., pt. 1, p. 15, pl. 2, figs. 8–14, 1886.
Lyothyrina wyvillii DALL, Bull. Mus. Comp. Zool., vol. 43, No. 6, p. 444, 1908.

Type locality.—As Davidson appears to have selected no special locality among those he enumerates in the *Challenger* Report, I choose station 299, off Valparaiso, Chile, in 2,160 fathoms, gray mud, bottom temperature 34° F.

Cat. No.	Locality.	Collector.	Number of specimens.
110745	Southwest of Galapagos Islands, 2,030 fathoms	B. F..............	3

This should not be confused with *Waldheimia wyvillii* dredged by the *Challenger* in the same haul, or *Terebratulina* (*Dyscolia*) *wyvillii* both described by Davidson. The brachia though very short exhibited both median and lateral coils.

GRYPHUS CLARKEANA Dall.

Liothyrina clarkeana DALL, Proc. U. S. Nat. Mus., vol. 17, p. 718, pl. 31, figs. 9, 10, 1895; Bull. Mus. Comp. Zool., vol. 43, No. 6, p. 443, Oct., 1908.

Type locality.—Gulf of Panama, 1,175 fathoms, U. S. Bureau of Fisheries, bottom temperature 36° 8 F.

Cat. No.	Locality.	Collector.	Number of specimens.
107275	Gulf of Panama, 1,175 fathoms..............	B. F..............	1
110742	Southwest of Galapagos Islands, 2,035 fathoms	B. F..............	1

Only these two specimens are yet known.

Section CNISMATOCENTRUM Dall.

Crural plates appressed solidly to the valve below the dental plates, the loop thus appearing to spring from the valve instead of from the hinge; a short median ridge below the loop.

Type.—*Gryphus sakhalinensis* Dall.

GRYPHUS SAKHALINENSIS Dall.

Terebratula (*Liothyris*) *sakhalinensis* DALL, Nautilus, vol. 22, No. 3, 1908, p. 28.

Type locality.—Okhotsk Sea, off the southeast coast of Sakhalin Island, in 64 to 100 fathoms, bottom temperature 30° F.

Cat. No.	Locality.	Collector.	Number of specimens.
110786	Southeast coast Sakhalin, 64 fathoms	B. F.	2
110787	Southeast coast Sakhalin, 64 fathoms	B. F.	1
10788	Southeast coast Sakhalin, 100 fathoms	B. F.	1
222598	Chignik Bay, Alaska, 60 fathoms	B. F.	2

This very remarkable species has the genital sinuses reticulate, rather behind the middle of the valve, and occupying for so large a shell relatively small space. The cardinal process is small but very prominent. The whole shell is much more solid than most Terebratuloids; it has a few obsolete radial striae on each side, and a very regular, conspicuous, and close system of punctation. The spiculation is not visible under an ordinary hand lens. All the specimens are of a brownish color.

Genus DYSCOLIA Fischer and Oehlert.

Dyscolia FISCHER and OEHLERT, Journ. de Conchyl., vol. 38, p. 70, 1890; Exp. Sci. du *Travailleur* et du *Talisman*, p. 18, Sept. 1891, type, *Terebratulina wyvillii* Davidson.

DYSCOLIA WYVILLI Davidson.

Terebratulina wyvilli DAVIDSON, Proc. Roy. Soc., vol. 27, p. 436, 1878.
Terebratulina wyvillii DAVIDSON, *Challenger* Brach., p. 32, pl. 1, figs. 1–2, 1880; Mon. Rec. Brach., pt. 1, p. 32, pl. 3, figs. 1–3, 1886.
Dyscolia wyvillei FISCHER and OEHLERT, Journ. de Conchyl., vol. 38, p. 70, 1890; Bull. Soc. Zool. de France, vol. 4, p. 120, 1890; Exp. Sci. du *Travailleur* et du *Talisman*, p. 23, fig. 1, pl. 6, figs. 3 *a–e*, 1891.
Terebratula asturiana FISCHER, Ms. in Jeffreys Collection.

Type locality.—Off Culebra Island, northwest of St. Thomas, West Indies, at station 24 in 390 fathoms sand.

Cat. No.	Locality.	Collector.	Number of specimens.
109797	Off Cape Finistére, Spain, 1051 fathoms	*Talisman*	fragm.

Genus CHLIDONOPHORA Dall.

Chlidonophora DALL, Trans. Wagner Inst., vol. 3, p. 1538, 1903, type, *Terebratulina incerta* Davidson.

CHLIDONOPHORA INCERTA Davidson.

Megerlia ? incerta DAVIDSON, Proc. Roy. Soc., vol. 27, p. 438, 1878; *Challenger* Brach., p. 49, pl. 11, figs. 17–18, 1880.
Terebratulina ? incerta DAVIDSON, Mon. Rec. Brach., pt. 1, p. 38, pl. 6, figs. 23–25, 1886.
Chlidonophora incerta DALL, Trans. Wagner Inst., vol. 3, p. 1538, 1903.

Type locality.—Between Sierra Leone, Africa, and the island of Fernando de Noronha, South Atlantic, dredged by the *Challenger* Expedition in 1,850 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
93776	Gulf of Mexico, 1,181 fathoms	B. F.	46
64254	Off Havana, 292 fathoms	*Blake*	3
64252	Off Bequia Island, 1,591 fathoms	*Blake*	29
64252*a*	Off Bequia Island, figd., 1,591 fathoms	*Blake*	1
64253	Off Bequia Island, 1,507 fathoms	*Blake*	2

CHLIDONOPHORA CHUNI Blochmann.

Chlidonophora chuni Blochmann in Chun, Aus den Tiefen des Weltemeers, vol. 2, p. 435, figs., 1903; Zool. Anz., vol. 30, 1906, p. 695; Zeitschr. f. wiss. Zool., vol. 90, p. 628, 1908.

Type locality.—*Valdivia* Expedition station 219, south of the Maldive Islands in 1,283 fathoms, bottom temperature 36° F.

Cat. No.	Locality.	Collector.	Number of specimens.
110436	Off the Maldives, 1,283 fathoms	*Valdivia*	1

Genus EUCALATHIS Fischer and Oehlert.

Eucalathis Fischer and Oehlert, Journ. de Conchyl., vol. 38, p. 72, 1890; Exp. Sci. du *Travailleur* et du *Talisman*, p. 40, 1891, type, *E. murrayi* Davidson.

EUCALATHIS MURRAYI Davidson.

Terebratula murrayi Davidson, Proc. Roy. Soc., vol. 27, p. 437, 1878.

Terebratulina murrayi Davidson, *Challenger* Brach., p. 39, pl. 2, figs. 1 *a–c*, 1880; Mon. Rec. Brach., pt. 1, p. 39, pl. 6, figs. 15–17, 1886.

Eucalathis murrayi Fischer and Oehlert, *Talisman* Exp. Brach., p. 40, 1891.

Type locality.—*Challenger* station 171, south of the Fiji Islands in 600 fathoms. Bottom temperature 37° 3 F.

Cat. No.	Locality.	Collector.	Number of specimens.
110848	Off Havana, 292 fathoms	*Blake*	1

EUCALATHIS TUBERATA Jeffreys.

Terebratula tuberata Jeffreys, Proc. Zool. Soc., 1878, p. 401, pl. 22, fig. 2.

Terebratulina tuberata Davidson, *Challenger* Brach., p. 13, 1880; Mon. Rec. Brach., pt. 1, p. 39, pl. 6, figs. 18–20, 1886.

Eucalathis tuberata Fischer and Oehlert, Expl. Sci. du *Travailleur* et du *Talisman*, p. 43, pl. 2, figs. 5 *a–f*, 1891.

Type locality.—Josephine Bank, off Gibraltar, in 340 to 430

Cat. No.	Locality.	Collector.	Number of specimens.
130341	Off the Sahara, 1,250 fathoms	*Talisman*	1
130342	Bay of Biscay, 1093 fathoms	*Travailleur*	1 v.
130343	Josephine Bank, 357 fathoms	Ital. Exped	2
130344	North of Azores, 1,496 fathoms	*Talisman*	1

? EUCALATHIS TRIGONA Jeffreys.

Terebratula trigona JEFFREYS, Proc. Zool. Soc., 1878, p. 402, pl. 22, figs. 3, 3*a*.
Terebratulina trigona DAVIDSON, Mon. Rec. Brach., pt. 1, p. 40, pl. 6, figs. 21, 22, 1886.

Type locality.—Off Portugal coast in 500 fathoms. Kent.

Cat. No.	Locality.	Collector.	Number of specimens.
130345	Off Portugal, 500 fathoms	Kent	1
130346	Bay of Biscay, 1,009 fathoms	*Travailleur*	3

EUCALATHIS ERGASTICA Fischer and Oehlert.

Eucalathis ergastica FISCHER and OEHLERT, Journ. de Conchyl., vol. 38, p. 73, 1890, Exp. Sci. du *Travailleur* et du *Talisman*, p. 48, pl. 3, figs. 6 *a–g*, 1891.

Type locality.—Off Cape Finistère, Spain, in 1,051 fathoms, *Travailleur* Expedition of 1881.

Cat. No.	Locality.	Collector.	Number of specimens.
130347	West of the Sahara, 346 fathoms	*Talisman*	3

Family MEGATHYRIDAE.

? Genus GWYNIA King.

Terebratula JEFFREYS, Ann. Mag. Nat. Hist., ser. 3, vol. 2, p. 125, 1859.
Gwynia KING, Proc. Dublin Univ. Zool.-Bot. Assoc., vol. 1, p. 258, figs. 1–5, 1859.
Terebratula REEVE, Conch. Icon. *Terebratula*, pl. 10, fig. 39, 1861.
Argiope JEFFREYS, British Conch., vol. 2, p. 21, 1863; vol. 5, p. 164, pl. 19, figs. 5, 1869; Proc. Zool. Soc., 1878, p. 410.
Gwynia DAVIDSON, Mon. Rec. Brach., pt. 2, p. 150, 1887.

Type.—*Gwynia capsula* Jeffreys.

GWYNIA CAPSULA Jeffreys.

Terebratula capsula JEFFREYS, Ann. Mag. Nat. Hist., ser. 3, vol. 3, p. 43, pl. 2, figs. 7 *a–b*, 1859.—REEVE, Conch. Icon., *Terebratula*, pl. 10, fig. 39, 1861.
Gwynia capsula KING, Proc. Dublin Univ. Zool. Bot. Assoc., vol. 1, p. 258, figs. 1–5, 1859.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 150, pl. 21, figs. 28 *a–c*, 29, 1887.
Argiope capsula JEFFREYS, Brit. Conch., vol. 2, p. 21, 1863; vol. 5, p. 164, pl. 19, fig. 5, 1869; Proc. Zool. Soc. 1878, p. 410.

Type locality.—Larne, County Antrim, Ireland.

Cat. No.	Locality.	Collector.	Number of specimens.
110961	Dublin Bay, 18 fathoms	Jeffreys	2
173617	Larne, Ireland	Jeffreys	14
173616	Island of Jersey, low water	Duprey	40
173611	Island of Jersey	Duprey	24
173612	Island of Jersey	Duprey	6
173619	Island of Guernsey, 20 fathoms	Jeffreys	12
173613	British Channel	France	7
173610	County Antrim, Ireland, 25 fathoms	Jeffreys	3
173615	Port Rush, Antrim, Ireland	Waller	1
173614	Belfast Bay, Ireland	Hyndman	1
173618	Fig'd. Brit. Conch., vol. 5, pl. 19, fig. 5	Jeffreys	4

Much discussion over this minute species has been had, especially as to whether it is a mature shell. It probably is in a permanently immature stage. Most of the specimens do not show any loop, but I have opened several of the larger ones which had a distinct loop with its lower edge cemented to the valve. I think the species is sufficiently distinct, though very near to *A. cistellula.*

Genus ARGYROTHECA Dall.

Cistella GRAY, Cat. Brit. Mus., p. 114, 1853.—H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 581, 1858.—DALL, Bull. Mus. Comp. Zool., vol. 3, No. 1, p. 19, 1871. Not *Cistella* Gistel, Naturg., p. XI, 1848.

Argyrotheca DALL, Nautilus, vol. 14, No. 4, Aug., 1900, p. 44.—J. ALLAN THOMSON, Austr. Antarctic Exp., Brachiopoda, p. 6, 1918.

Type.—Terebratula cuneata Risso, 1826.

ARGYROTHECA CISTELLULA S. Wood.

Terebratula cistellula S. WOOD, Ann. Mag. Nat. Hist., ser. 1, vol. 6, p. 253, 1841.—REEVE, Conch. Icon., *Terebratula*, pl. 10, fig. 46, 1861.

Argiope cistellula S. WOOD, Suppl. Crag. Moll., p. 170, pl. 11, figs. 4 *a–d*, 1874.—JEFFREYS, Brit. Conch., vol. 2, p. 19, pl. 1, fig. 2, 1863; vol. 5, p. 164, pl. 19, fig. 4, 1869.

Cistella cistellula GRAY, Brit. Mus. Cat. Brach., p. 114, 1853.—DALL, Amer. Journ. Conch., vol. 6, p. 146, 1870; Proc. Acad. Nat. Sci. Phila., for 1873, p. 194.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 139, pl. 22, figs. 1–4, 1887.

Megathyris cistellula FORBES and HANLEY, Brit. Moll., vol. 2, p. 361, pl. 57, fig. 9, 1850.

Type locality.—Fossil in Pliocene of Britain and recent off County Antrim, Ireland, Jeffreys.

Cat. No.	Locality.	Collector.	Number of specimens.
173404	Figd., Brit. Conch., vol. 5, pl. 19, fig. 4	Jeffreys	6
173405	Figd., Brit. Conch., vol. 2, pl. 7, fig. 2	Jeffreys	4
173419	Christiansund, Norway	Sars	1
173415	Kors fiord, Norway	Sars	10
173406	Zetland	Jeffreys	13
173407	Shetlands	Jeffreys	2
173408	Shetlands	Jeffreys	2
173409	Hebrides	Jeffreys	3
173410	Skye, 40 fathoms	Barlee	5
173411	Skye, 40 fathoms	Jeffreys	28
173412	Skye, 30 fathoms	McAndrew	2
173413	Exmouth	Barlee	1
173414	Weymouth	Damon	1
173415	Weymouth	Damon	20
173416	Bath Bay	Jeffreys	4
173420	English Channel	France	7
173417	Guernsey, 20 fathoms	Jeffreys	23
173421	Bay of Biscay	De Folin	2
173422	Sardinia	Verany	1
173423	Sicily	Stefanis	3

ARGYROTHECA CUNEATA Risso.

Terebratula cuneata RISSO, Hist. Nat. Eur. Mér., vol. 4, p. 388, pl. 12, fig. 179, 1826.—SOWERBY, Thes. Conch., p. 355, pl. 12, figs. 83, 84, 1846.

Terebratula soldaniana RISSO, Hist. Nat. Eur. Mér., vol. 4, p. 389, pl. 12, fig. 178, 1826.

Anomia pera MÜHLFELDT, Verh. Ges. Naturf. freunde zu Berlin, vol. 1, p. 205, 1829.

Terebratula pera KÜSTER, Conch. Cab., ed. 2, *Terebratula*, p. 30, pl. 2 *b*., figs. 14–17, 1848.

Orthis pera PHILIPPI, En. Moll. Sicil., vol. 2, p. 69, vol. 1, p. 96, pl. 6, fig. 13, 1844.—O. G. COSTA, Fauna de Regn. Napoli, p. 37, pl. 3*bis*, fig. 1, 1851.

Argiope cuneata DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 373, 1852; Proc. Zool. Soc., 1852, p. 81, pl. 14, fig. 27.—SHIPLEY, Mitth. Zool. Sta. Neapl., vol. 4, p. 495, 1883.

Cistella cuneata DALL, Proc. Acad. Nat. Sci. Phila., for 1873, p. 194.—DAVIDSON, Mem. Rec. Brach., pt. 2, p. 141, pl. 22, figs. 30–34, 1887.

Type locality.—Mediterranean, near Nice. Risso.

Cat. No.	Locality.	Collector.	Number of specimens.
110960	Mediterranean	Dall	1
173477	Mediterranean, 40 fathoms	Capt. Nares	20
173478	Mediterranean	Issel	2
173475	Aegean Sea	Capt. Nares	24
173479	Mediterranean	Weinkauff	1

Variety PERA Mühlfeldt.

Cat. No.	Locality.	Collector.	Number of specimens.
173474	Spezzia	J. Doria	4
173473	Zara, Adriatic Sea	Jeffreys	1
173472	Malta	Gibson	2
173476	Aegean Sea, 30–200 fathoms	Nares	4
173469	Tunis, 40–70 fathoms	Carpenter	30
173470	Sicily	Stefanis	1

ARGYROTHECA CUNEATA, var. PANTELLARIA Jeffreys.

Cistella pantellaria Jeffreys, Davidson, Mon. Rec. Brach., pt. 2, p. 142, 1887.

Type locality.—Sicily. Red markings absent.

Cat. No.	Locality.	Collector.	Number of specimens.
173471	Naples	Stefanis	3

ARGYROTHECA BERMUDANA Dall.

Argyrotheca bermudana Dall, Nautilus, vol. 25, No. 8, Dec. 1911, p. 86.
Cistella cistellula Verrill, Trans. Conn. Acad., vol. 10, 1900, p. 592, pl. 70, fig. 7; not of Searles Wood.

Type locality.—Bermuda.

Cat. No.	Locality.	Collector.	Number of specimens.
228683	Harrington Sound, Bermuda	Haycock	7

This differs from *A. woodwardiana* Davidson of the West Indies in the absence of lateral angles to the hinge-line and of the median sulcation. It has much the form of *A. lunifera* Philippi.

ARGYROTHECA CORDATA Risso.

Terebratula cordata Risso, Hist. Nat. Eur. Mér., pl. 4, p. 389, 1826.—Davidson, Ann. Mag. Nat. Hist., ser. 4, vol. 3, p. 375, 1869.—Monterosato, Nomen. Conch. Medit., p. 2, 1884.—Davidson, Ann. Mag. Nat. Hist., ser. 4, vol. 3, p. 375, 1869.
Terebratula neapolitana Scacchi, Oss. Zool., vol. 2, p. 18, 1833; Cat. Conchyl. Regn. Neap., p. 8, 1836.
Orthis neapolitana Philippi, En. Moll. Sicil., vol. 2, p. 69, 1844.—O. G. Costa, Fauna Reg. Nap., p. 37, pl. 3, figs. 1, 3, 5, 1851.

Argiope neapolitana DAVIDSON, Proc. Zool. Soc., 1852, p. 81, pl. 14, figs. 24, 25.—KOVALEVSKI, Obs. Dev. Brach. (Russ. 1874) see Arch. Zool. Exp., ser. 2, vol. 1, pp. 55–76, 1883.—SHIPLEY, Mitth. Zool. Station zu Neapel., vol. 4, p. 494, 1883.

Argiope for[illegible] D[illegible]IDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 373, 1852.

Cistella neapolitana DALL, Amer. Journ. Conch., vol. 6, p. 146, 1871; Proc. Acad. Nat. Sci. Phila. for 1873, p. 194.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 131, pl. 22, figs. 8–24, 1886.

Argiope biplicata SEGUENZA, Rend. Accad. Sci. Napoli, vol. 15, pp. 123–4, 1876.

Argiope kowalevskii SCHULGIN, Zeits. f. Wiss. Zool., vol. 41, p. 122, pl. 41, figs. 7–9, 12; pl. 42, figs. 14–31, 1884.

Type locality.—Mediterranean near Nice, coralline zone; Risso.

Cat. No.	Locality.	Collector.	Number of specimens.
173450	Gulf of Naples	Stefanis	1
173447	Gulf of Naples	Costa	1
173459	Gulf of Naples	Issel	5
11886	Mediterranean	Damon	2
173451	Mediterranean, 40 fathoms	Capt. Nares	14
173442	Sicily	Stefanis	10
202475	Sicily	Stefanis	5
173446	Sardinia	Verany	1
173444	Tunis coast	*Shearwater* Exp	2
173445	Tunis coast	Capt. Nares	1
173443	Tunis coast	Carpenter	1
173453	Malta	Gibson	2
173452	Pantellaria Ids	Capt. Nares	28
173454	Dalmatia	Brusina	1
173456	Spezzia	J. Doria	1
173457	Aegean Sea	Spratt	1
173458	Aegean Sea	Capt. Nares	1
14746	Canary Ids	McAndrew	1

ARGYROTHECA CORDATA, new variety EXOPLEURA.

Brown, ribless, bilobed, with prominent beak.

Cat. No.	Locality.	Collector.	Number of specimens.
173448	Gulf of Naples	Tiberi	4
173449	Gulf of Naples	Acton	4
173452*a*	Pantellaria Islands	Capt. Nares	4
173454*a*	Dalmatia	Brusina	1
173455	Zara	Jeffreys	1

The variety forms quite a contrast with the ribbed, wider, and less triangular *cordata*, and may on more thorough investigation prove distinct. The specimens when full grown are uniformly larger than the typical form.

ARGYROTHECA BARRETTIANA Davidson.

Argiope barrettiana DAVIDSON, Proc. Zool. Soc., Feb. 1866, p. 103, pl. 12, fig. 3.
Argiope antillarum CROSSE and FISCHER, Journ. de Conchyl., vol. 14, p. 270, pl. 8, fig. 7, July, 1866.

Type locality.—Northeast coast of Jamaica, West Indies, in 150 fathoms. Lucas Barrett.

Cat. No.	Locality.	Collector.	Number of specimens.
87532	Off Cape Florida, 193 fathoms	B. F.	1
93405	Off Cape Florida, 85 fathoms	B. F.	1
64229	Gulf of Mexico, 101 fathoms	*Blake*	5
64228	Off Havana, 805 fathoms	*Blake*	1
64247	Tongue of Ocean	B. F.	1
314863	Barbados	Henderson	3½

This is a much larger species than *A. schrammi* though the coloration is similar.

ARGYROTHECA LUTEA Dall.

Cistella lutea DALL, Bull. Mus. Comp. Zool., vol. 3, p. 20, pl. 1, figs. 5, 5*a*.; pl. 2, figs. 4–8, 1871; vol. 12, p. 203, 1886.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 142, pl. 23, figs. 5, 6, 1887.

Type locality.—Tortugas, 30–43 fathoms. Pourtales.

Cat. No.	Locality.	Collector.	Number of specimens.
92495	Off Cape Hatteras, 49 fathoms	B. F.	1
32924	Tortugas Pass, 43 fathoms	Pourtales	2
110963	Tortugas Pass, 30 fathoms	Pourtales	3
64245	Off Havana, 80–127 fathoms	Sigsbee	3
314884	Barbados, 30–70 fathoms	Henderson	6
314878	Barbados, 35–75 fathoms	Henderson	3
64246	Barbados, 100 fathoms	*Blake*	2
314879	Barbados, 90–100 fathoms	Henderson	4
314880	Barbados, 33 fathoms	Henderson	4
314881	Barbados, 50–60 fathoms	Henderson	2
314882	Barbados, 65–70 fathoms	Henderson	1
314883	Barbados	Henderson	2
62342	Off Rio Janeiro, 70 fathoms	Norseman	1

ARGYROTHECA SCHRAMMI Crosse and Fischer.

Argiope schrammi CROSSE and FISCHER, Journ. de Conchyl., vol. 14, p. 269, pl. 8, fig. 6, July, 1866.
Cistella (? *schrammi* var.) *rubrotincta* DALL, Bull. Mus. Comp. Zool., vol. 3, p. 19, pl. 1, figs. 6, 6*a*., 1871.
Cistella barrettiana var. *rubrotincta* DALL, Bull. Mus. Comp. Zool., vol. 12, p. 203, 1886.

Type locality.—Island of Guadeloupe, West Indies, in 100 to 125 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
82923	Florida Keys	Pourtales	2
110962	Tortugas, 43 fathoms	Pourtales	5
64231	Barbados, 100 fathoms	*Blake*	6
314876	Barbados, 50–60 fathoms	Henderson	Many.
314877	Barbados, 33 fathoms	Henderson	Many.
314864	Barbados, 100 fathoms	Henderson	1
314865	Barbados, 75–80 fathoms	Henderson	18
314866	Barbados, 30–70 fathoms	Henderson	Many.
314868	Barbados, 80 fathoms	Henderson	12
314869	Barbados, 75 fathoms	Henderson	27
314890	Barbados, 75–80 fathoms	Henderson	4
314875	Barbados, 80 fathoms	Henderson	38
314872	Barbados, 40–75 fathoms	Henderson	24
314873	Barbados, 35–75 fathoms	Henderson	26
314871	Barbados, 35	Henderson	1
314874	Barbados, 25–72 fathoms	Henderson	18
314867	Antigua, 120 fathoms	Henderson	4
64230	Grenada, 170	*Blake*	1

Some confusion was caused by the fact that the coloration of Davidson's *A. barrettiana* and of this species is similar, while Crosse and Fischer figured one of the rare unicolorate specimens to illustrate their *A. schrammi*. But the reception of many specimens has enabled me to clear this up, the former species being many times larger than the latter which is extremely uniform. If the difference in color be regarded as of varietal rank, the name *rubrotincta* would apply to the specimens with scarlet radial lines.

Genus MEGATHYRIS Orbigny.

Megathiris ORBIGNY, Comptes Rendus, vol. 25, pp. 192, 269, 1847; Ann. Sci. Nat., Zool., ser. 3, vol. 8, p. 341, 1847.

Megathyris BRONN, Jahrbuch für Mineral., p. 244, 1848.

Argiope DESLONGCHAMPS, Mém. Soc. Lin. de Normandie, vol. 7, p. 9, 1842; not *Argiope* Savigny, 1827.

MEGATHYRIS DETRUNCATA Gmelin.

Anomia decollata CHEMNITZ, Conch. Cab., vol. 8, p. 96, pl. 98, fig. 705 *a–d.*, 1785 (not binomial).

Anomia detruncata GMELIN, Syst. Nat., p. 3347, 1791.

Anomia decollata DILLWYN, Descr. Cat. Rec. Sh., vol. 1, p. 292, 1817.

Terebratula detruncata BLAINVILLE, Dict. Sci. Nat., vol. 53, p. 141, 1828.—PHILIPPI, En. Moll. Sicil., vol. 1, p. 96, pl. 6, fig. 14, 1836.—FORBES, Aegean Sea, p. 141, 1844.

Terebratula aperta BLAINVILLE, Dict. Sci. Nat., vol. 53, p. 144, 1828.

Terebratula urna-antiqua RISSO, Hist. Nat. Eur. Mér., vol. 4, p. 388, pl. 12, fig. 177, 1826.

Terebratula cardita RISSO, Hist. Nat. Eur. Mer., vol. 4, p. 389, pl. 12, fig. 180, 1826.

Terebratula decollata DESHAYES in Lamarck, Anim. s. Vert., ed. 2, vol. 7, p. 350, 1836.

Terebratula dimidiata SCACCHI, Osserv. Zool., p. 17, 1833.

Argiope decollata DESLONGCHAMPS, Mém. Soc. Lin. de Normandie, vol. 7, p. 9, 1842.
Orthis detruncata PHILIPPI, En. Moll. Sicil., vol. 2, p. 69, 1844.
Megathiris detruncata ORBIGNY, Ann. des Sci. Nat., sér. 3, vol. 8, p. 341, 1847.
Terebratula pectiniformis O. G. COSTA, Mém. Accad. Real. Sci. di Napoli, vol. 5, p. 39, pl. 1, fig. 6, 1852.
Megathyris decollata DALL, Amer. Journ. Conch., vol. 6, p. 145, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 193.
Argiope decollata JEFFREYS, Proc. Zool. Soc. 1878, p. 409.—DAVIDSON, *Challenger* Brach., p. 57, pl. 4, figs. 12, 13, 1880; Mon. Rec. Brach., pt. 2, p. 128, pl. 21, figs. 30–35, 1886.

Type locality.—Mediterranean Sea.

Cat. No.	Locality.	Collector.	Number of specimens.
11889	Mediterranean	Damon	5
21930	Mediterranean	Crosse	1
173425	Figd. Brit. Conch. V, pl. XIX, fig. 3	Jeffreys	3
173426	Cape Breton, France	Jeffreys	1
198844	Corsica	Lea Coll	1
173427	Corsica	Susini	2
173433	Naples	Dohrn	1
173434	Naples	Tiberi	1
174939	Algerine coast, 51 fathoms	*Porcupine* Exp	6 v.
174938	Off Morocco, 128 fathoms	*Porcupine* Exp	8
173429	Skerke Bank, 30–120 fathoms	*Porcupine* Exp	2
174941	Adventure Bank, 92 fathoms	*Porcupine* Exp	6 v.
174940	Benzert Roads	*Porcupine* Exp	6
173430	Tunis coast, 40–120 fathoms	*Porcupine* Exp	3
173431	Tunis coast, 80–120 fathoms	Capt. Nares	20
173432	Aegean Sea, 40 fathoms	Capt. Nares	30
173438	Aegean Sea, 130 fathoms	Spratt	10
173435	Adriatic Sea	Stossich	1
173436	Adriatic Sea	Parreys	1
173437	Adriatic Sea	Brusina	2
173439	Off Crete, 70–120 fathoms	Spratt	1
173440	Mediterranean	Issel	1
173441	Mediterranean, 30 fathoms	Capt. Nares	11
130332	Off Isles deserts, Africa, 54 fathoms	*Travailleur*	2
199368	Off "Guadeloupe" (?)	Ancey	3

The first binomial valid name given to this species is that of Gmelin. The name *ungula*, applied by Retzius to an unidentifiable figure in Gualtieri, is earlier, but the figure is not only unidentifiable but bears not the slightest resemblance to the present species.

The specimen received from Ancey was labeled by him *Argiope cordata* and said to have been collected by Marshall. That it really came from Guadeloupe may well be questioned. The specimens are identical with the Mediterranean form. The usual variations in the number of ribs, convexity and lateral extension, run through the series above enumerated.

Family TEREBRATELLIDAE.

Subfamily DALLININAE.

Genus PLATIDIA O. G. Costa.

Platidia O. G. COSTA, Fauna del Regno Napoli, p. 47, Jan. 1852.
Morrisia DAVIDSON, Ann. Mag. Nat. Hist., May, 1852, p. 371.
Platydia DAVIDSON, Mon. Rec. Brach., vol. 2, p. 152, 1887.

PLATIDIA SEMINULA Philippi.

Terebratula seminulum PHILIPPI, En. Moll. Sicil., vol. 1, p. 97, pl. 6, figs. 15 *a-g*, 1836.
Orthis anomioides SCACCHI and PHILIPPI, En. Moll. Sicil., vol. 2, p. 69, pl. 18, figs. 9 *a-g*, 1844.
Terebratula appressa FORBES, Rep. Moll. Aegean Sea, pp. 141, 167, 193, 1844.
Platidia anomioides O. G. COSTA, Fauna del Regno Napoli, p. 48, pl. 3, fig. 4; pl. 3*bis*, fig. 6, 1852.
Morrisia seminulum DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 371, 1852.
Morrisia anomioides DAVIDSON, Proc. Zool. Soc., 1852, pl. 14, fig. 29.
Platidia (Morrisia) anomioides DAVIDSON, Geol. Mag., vol. 7, p. 405, pl. 21, figs. 15, 15*a*, 1870.
Platidia anomioides DALL, Amer. Journ. Conch., vol. 6, p. 14, figs. 20, 21, 1870.—DAVIDSON, *Challenger* Brach., p. 55, pl. 4, figs. 10, 11, 1880.—ZITTEL, Handb. d. Pal., vol. 2, p. 708, 1880.—DESLONGCHAMPS, Etudes Crit. Brach., p. 160, pl. 13, fig. 19, 1884.
Platidia seminulum MONTEROSATO, Journ. de Conchyl., vol. 27, p. 307, pl. 13, fig. 3, 1879.
Platydia anomioides DAVIDSON, Mon. Rec. Brach., pt. 2, p. 152, pl. 21, figs. 15–19, 1887.

Type locality.—Sicily.

Cat. No.	Locality.	Collector.	Number of specimens.
173446	Sicily	Monterosato	1
173464	Sicily	Seguenza	2
173460	Cape Breton, France	De Folin	1
173461	Gulf of Gascony	De Folin	1
173462	Portugal coast	Kent	4
60932	Portugal coast 500 fathoms	Dall	1
110964	Mediterranean	Dall	1
173467	Naples	Tiberi	1
173468	Naples	Tiberi	3
173463	Off Tunis	*Porcupine* Exp	3
173465	Adventure Bank	*Shearwater* Exp	20
87346	Fernandina, Florida, 294 fathoms	*Blake*	1 v
110965	Tortugas, Florida, 237 fathoms	Pourtales	1
64234	Off Havana, 292 fathoms	*Blake*	1
87251	Off Havana, 119 fathoms	*Blake*	1
64233	Off Grenada, 291 fathoms	*Blake*	1

PLATIDIA SEMINULA RADIATA Dall.

210058	Off Point Pinos, California, 50 fathoms	B. F	1
107727	San Pedro Bay, California, 200 fathoms	Oldroyd	25
60930	Types, San Diego, California	Orcutt	2
60931	Todos Santos Bay	Orcutt	1
64232	Off Santa Cruz Island, West Indies, 218 fathoms.	*Blake*	1

The variety was described in the Proceedings of the U. S. National Museum[1] from beach drift collected by C. R. Orcutt at San Diego, California. It differs from the normal type by having fine radiating lines on the upper valve.

PLATIDIA JAPONICA, new species.

Shell resembling *P. seminula* but much larger, the valves when normally developed relatively wider, the foramen entirely confined to the attached valve, the free valve having the apex entire and a very narrow long flattish area on each side; the soft parts, so far as could be determined from a dry specimen softened in weak liquor potassae, do not differ in arrangement from the Mediterranean species. Height 5.3, width 7.5, diameter 1.3 mm.

Type locality.—Off Hondo, Japan, in 65 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
110966	Off Hondo, Japan, 65 fathoms	B. F	15
110956	Yokohama, Japan	F. Stearns	1

The Yokohama specimen was adhering to the shell of *Terebratulina crossei* Davidson.

Type.—Cat. No. 110966, U.S.N.M.

Subfamily MUHLFELDTIINAE.

Genus MÜHLFELDTIA Bayle.

Megerlia KING, Permian Foss., pp. 81, 145, 1850.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 103, 1887 (section "A" only).

Megerlea DAVIDSON, Introd. Brach., p. 129, 1856.

Megerlia DALL, Amer. Journ. Conch., vol. 6, p. 129, 1871; not of Robineau Desvoidy, 1830.

Mühlfeldtia BAYLE, Journ. de Conchyl., vol. 28, 1880, p. 240.

Type.—*Anomia truncata* Linnaeus.

MÜHLFELDTIA DISCULUS Pallas.

Anomia disculus PALLAS, Misc. Zool., p. 184, pl. 14, fig. 1 *a–g*, 1766.

Anomia truncata LINNAEUS, Syst. Nat., ed. 12, p. 1152, 1767.—BORN, Mus. Vindob., p. 118, pl. 6, fig. 14, 1778.

Terebratula truncata RETZIUS, Diss. Nov. Gen. Test., p. 14, 1788.

Delthyris truncata ANTON, Verz. Conch., p. 22, 1839.

Orthis oblita MICHELOTTI, Foss. Mioc. Ital., pl. 1, fig. 21, 1847.

Megerlia truncata KING, Permian Foss., p. 140, 1850.—DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 369, 1852; Mon. Rec. Brach., pt. 2, p. 103, pl. 19, figs. 11–20, 1887.

Mühlfeldtia truncata FISCHER and OEHLERT, Expl. *Travailleur* et du *Talisman*, p. 80, 1891.

Type locality.—Mediterranean.

[1] Vol. 8, p. 551, Sept. 30, 1885.

Cat. No.	Locality.	Collector.	Number of specimens.
11885	Mediterranean	Damon	2
14560	Mediterranean	Damon	2
110954	Mediterranean	Dall	10
21965	Mediterranean	Cuming	1
131052	Mediterranean	Chamberlain	2
174935	Mediterranean	Jeffreys	Many.
173790	Torbay, England	Turton	1
173791	Cape Breton, France	De Folin	1
173792	Cape Breton, France	De Folin	1 yo.
174936	West of Portugal	*Porcupine* Exp	1
173838	Gulf of Naples	Dohrn	17
173831	Gulf of Naples	Issel	4
173825	Gulf of Naples	Stefanis	1
173826	Gulf of Naples	Tiberi	1
173827	Gulf of Naples	Tiberi	4
173818	Corsica	Susini	1
173819	Corsica	Susini	15
173820	Ajaccio	Susini	1
173821	Ajaccio	Susini	1 yo.
173822	Sicily	Sowerby	1
173823	Pantellaria Islands	Capt. Nares	2
173800	Pantellaria Islands	*Shearwater* Exp	1
173837	Adventure Bank	Capt. Nares	1
173801	Adventure Bank	*Shearwater* Exp	3
173817	Adventure Bank	*Shearwater* Exp	6
173796	Skerke Bank	*Shearwater* Exp	3
173794	Skerke Bank	*Shearwater* Exp	20
173795	Benzert Roads, Tunis	Carpenter	10
173797	Benzert Roads, Tunis	*Shearwater* Exp	2
174937	Off Morocco coast	*Porcupine* Exp	1
173798	West of Soloom Bay	*Shearwater* Exp	3
173799	Tunis coast	Capt. Nares	1
173828	Aegean Sea	Spratt	1
173829	Aegean Sea	Spratt	20
173830	Aegean Sea	Capt. Nares	1
11781	New South Wales (?)	Angas	1

MÜHLFELDTIA DISCULUS GRANOSA Seguenza.[1]

173795	Benzert Roads, Tunis	*Shearwater* Exp	10
173796	Skerke Bank, Tunis	*Shearwater* Exp	1
173798	West of Soloom Bay, Tunis	*Shearwater* Exp	1
173799	Coast of Tunis	Capt. Nares	1
173800	Off Pantellaria Islands	*Shearwater* Exp	1
173801	Adventure Bank	*Shearwater* Exp	2
173817	Advanture Bank	*Shearwater* Exp	3
173822	Sicily	Sowerby	1

[1] *Megerlia granosa* Seguenza, Pal. Mal. Terz. Messina, p. 65, 1865; and Form. Terz. Calabria, p. 190, 1880.

The more northern specimens of this species show usually radial threads, rarely somewhat imbricated, but a large proportion of those from the south shore of the Mediterranean are more or less distinctly granulose, the granules, especially those situated laterally near the beak, sometimes are produced into short prickles, easily worn off.

Genus PANTELLARIA Dall.

Pantellaria DALL, Proc. Biol. Soc. Wash., vol. 32, p. 251, 1919.

The genus *Mühlfeldtia* is characterized among other things by the peduncular foramen being normally confined to the beaked valve as in most Terebratellidae, the extension of the foramen to the brachial valve being due to wear and to that extent abnormal; both valves are free and similarly sculptured. In the present genus the foramen normally is confined to the brachial valve, only by wear encroaching on the other; the brachial valve is applied to the substratum, reproducing its irregularities and except for those is smooth, while the upper valve has radial sculpture.

Type.—*Mühlfeldtia monstruosa* Scacchi.

PANTELLARIA MONSTRUOSA Scacchi.

Terebratula monstruosa SCACCHI, Osserv. Zool., No. 2, p. 17, 1838; Cat. Conch. Regn. Napoli, p. 8, 1836 (name only).—O. G. COSTA, Fauna del Regn. di Napoli, p. 43, pl. 9, figs. 4, 5, 1851.

Megerlia truncata var. *monstruosa* MONTEROSATO, Poche note s. Conch. Medit. p. 4, 1875.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 108, pl. 19, figs. 21, 22*a*, 1887.

Mühlfeldtia monstruosa FISCHER and OEHLERT, Exp. Sci. du *Travailleur* et du *Talisman*, p. 87, pl. 7, figs. 12 a–c, 1891.

Type locality.—Naples, Italy.

Cat. No.	Locality.	Collector.	Number of specimens.
173791	Cape Breton, France	De Folin	1
173793	Bay of Biscay	De Folin	5
173835	Mediterranean	Jeffreys	1
173818	Corsica	Susini	......
173820	Ajaccio, Corsica	Susini	1
173822	Sicily	Sowerby	1
173833	Palermo	Monterosato	1
173836	Naples	Tiberi	1
110955	Gulf of Naples	Dall	2
173825	Gulf of Naples	Tiberi	1
173825a	Gulf of Naples	Stefanis	1 yo.
173828	Ægean Sea	Spratt	3 v.
173832	Adriatic Sea	Issel	1

This species, with the loop of *Mühlfeldtia*, has a foramen and lower valve like that of *Platidia*. Most of the figures indicate the foramen as encroaching on the upper valve, but this is abnormal. An examination of a perfectly unworn specimen will show conclusively that the foramen is normally entirely confined to the brachial valve.

PANTELLARIA ECHINATA Fischer and Oehlert.

Mühlfeldtia echinata FISCHER and OEHLERT, Journ. de Conchyl., vol. 38, p. 73, 1890; Exp. Sci. du *Travailleur* et du *Talisman*, p. 90, pl. 7, figs. 13*a–g*, text fig. 8, 1891.

? *Morrisia gigantea* DESHAYES, Cat. Moll. Isle Réunion, p. 37, pl. 5, figs. 9, 10, 11, 1863.

Type locality.—Off Cape Bojador, Sudan coast of West Africa, in 640 to 782 meters.

Cat. No.	Locality.	Collector.	Number of specimens.
130333	Off Cape Bojador, 407 fathoms	*Talisman* Exp.	4
173834	Cape of Good Hope, 224 fathoms	Jeffreys	1
11781	New South Wales	Angas	1
64436	Barbados, 100 fathoms	*Blake*	1
274171	Sand Key, Florida	Henderson	1

Deshayes species has much the aspect of *P. echinata* with the spines worn off, and in view of the wide distribution of the latter, if not a distinct species, is more likely to belong to the *echinata* than to the closely allied *monstruosa*, which appears to be confined to the west coast of France and Spain and the Mediterranean. Not having seen a specimen of Deshayes' shell, only a tentative opinion can be expressed as to its relations.

Genus FRENULINA Dall.

Megerlia DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 369, 1852.

Ismenia A. ADAMS, Ann. Mag. Nat. Hist., ser. 3, vol. 11, p. 99, 1863.—DALL, Amer. Journ. Conch., vol. 6, p. 127, 1870; Proc. Acad. Sci. Nat. Phila. for 1873, p. 187; Bull. U. S. Nat. Mus., No. 8, p. 39, 1877.

Megerlia (sect. B) DAVIDSON, Mon. Rec. Brach., pt. 2, p. 108, 1887.

Frenulina DALL, Proc. U. S. Nat. Mus., vol. 17, p. 724, 1894.

Type.—*Anomia sanguinolenta* Gmelin.

FRENULINA SANGUINOLENTA Gmelin.

Anomia sanguinea CHEMNITZ, Conch. Cab., vol. 8, p. 96, pl. 78, fig. 706, 1785 (not binomial).

Anomia sanguinolenta GMELIN, Syst. Nat., p. 3347, 1792.—DILLWYN, Descr. Cat. Rec. Shells, vol. 1, p. 293, 1817.

Terebratula cruenta (Solander MS.) DONOVAN, Nat. Repository, vol. 2, pl. 56, fig. 1, 1824.

Terebratula sanguinolenta BLAINVILLE, Dict. Sci. Nat., vol. 53, p. 142, 1828.

Terebratula erythroleuca QUOY and GAIMARD, Voy. *Astrolabe*, vol. 3, p. 557, pl. 85, figs. 8, 9, 1834.

Terebratula pulchella SOWERBY, Thes. Conch. *Terebratula*, pl. 71, figs. 105–107, 1847.

Ismenia reevei A. ADAMS, Ann. Mag. Nat. Hist., ser. 3, vol. 11, p. 99, 1863.—DAVIDSON, Proc. Zool. Soc., 1871, p. 308, pl. 31, fig. 3.

Frenula sanguinea ZITTEL, Handb. d. Palaeont., p. 708, 1880.

Megerlia sanguinea DAVIDSON, Mon. Rec. Brach., pt. 2, p. 108, pl. 20, figs. 1–8; var. *reevei*, figs. 12, 12 *b*, 1887.

Type locality.—"East Indies." Mindanao, Philippines.

Cat. No.	Locality.	Collector.	Number of specimens.
17820	Hawaiian Islands	Pease	5
77273	Hawaiian Islands	Pease	4
41700	Hawaiian Islands	Dall	1
110953	Hawaiian Islands	Dall	4
107024	Hawaiian Islands, 298 fathoms	B. F	1
274172	Molokai, 24 fathoms	B. F	1
274173	French Frigate Shoal, 17 fathoms	B. F	1
237239	Mindanao, Philippine Islands, 28 fathoms	B. F	1 v.
295330	Mindanao, Philippine Islands, 100 fathoms	B. F	1 v.
237268	Mindanao, Philippine Islands, 48 fathoms	B. F	1
237173	Mindanao, Philippine Islands, 20 fathoms	B. F	3
237303	Mindanao, Philippine Islands, 21 fathoms	B. F	1
294569	Off Jolo, Philippine Islands, 22 fathoms	B. F	10
235462	Off Jolo, Philippine Islands, 22 fathoms	B. F	1
293985	Off Jolo, Philippine Islands, 21 fathoms	B. F	7
294106	Off Jolo, Philippine Islands, 29 fathoms	B. F	5 v.
229424	Off Jolo, Philippine Islands, 318 fathoms	B. F	1 v.
294222	Off Jolo, Philippine Islands, 19 fathoms	B. F	2
239692	Off Jolo, Philippine Islands	B. F	1
239524	Off Jolo, Philippine Islands	B. F	1
230386	Off Jolo, Philippine Islands, 20 fathoms	B. F	1
246325	Off North Burias Islands, 105 fathoms	B. F	1 v.
229554	Off Mindoro Islands, 162 fathoms	B. F	3 fr.
229587	Off Mindoro Islands, 162 fathoms	B. F	1 v.
235916	Sulu Archipelago, 17 fathoms	B. F	3
236281	Off Tawitawi Islands, 10 fathoms	B. F	1
292546	Off Tawitawi Islands, 17 fathoms	B. F	25
292029	Off Tawitawi Islands, 24 fathoms	B. F	1
295154	Off Tawitawi Islands, 10 fathoms	B. F	2
297244	Observation Island, 46 fathoms	B. F	1
300394	Off East Cebu Island, 165 fathoms	B. F	1 v.
293469	Off East Panay Island, 126 fathoms	B. F	1
235258	Off Corregidor Island, 13 fathoms	B. F	2
237132	Pakiputan Strait, 23 fathoms	B. F	1
335493	South Pangosinan, 19 fathoms	B. F	2
236659	Off northeast Tables Island, 37 fathoms	B. F	2
300121	Off Celebes, 37 fathoms	B. F	1

The variety *reevei* differs only by being pure white according to Davidson, but his figure is sufficiently different to create a doubt. Among the large number I have handled, none has come from Japan, and none corresponds to Davidson's figure or A. Adams's description. I have not seen any Japanese specimens.

FRENULINA ALCOCKI Joubin.

Kingena alcocki JOUBIN, Bull. Mus. d'hist. Nat. Paris, vol. 12, for 1906, p. 529, text figures 1, 2, 1907.

Type locality.—Indian Ocean, south of India, in 187 fathoms. Alcock.

Cat. No.	Locality.	Collector.	Number of specimens.
111056	Sulu Sea	*Valdivia* Exp	1
227823	Off south India, 187 fathoms	Alcock	1

The above mentioned specimens were sent me by Doctor Blochmann. On examination of the loop I am compelled to the conclusion that the details do not agree with the type of the genus *Kingena* as figured from the original fossil, but that there is really no essential difference between the loop of *alcocki* and *Frenulina sanguinolenta*. I have therefore referred the species to *Frenulina*.

FRENULINA MAUIËNSIS, new species.

Shell large for the genus, pale brown, medially slightly compressed, moderately convex; valves sculptured only with concentric growth lines at wide intervals, and a very obvious minute and dense punctuation; pedicel valve with rather elevated and incurved beak, the foramen entire, the deltidia more or less coarsely wrinkled and seemingly not meeting but united by an irregular plug between their proximal edges; hinge teeth strong and close together with props in the younger shells which are solidly cemented to the wall of the shell in the adult; no traces of any medial ridge or septum; the anterior margins of the valves pinched together medially but not perceptibly folded; brachial valve less convex, cardinal plate solidly united over the septum, excavated in the middle, with strong dental sockets and no cardinal process, the septum thin, high and short, not extending beyond the middle of the valve distally; crura short, widely triangular; the lower limbs of the loop of almost hairlike tenuity, the reflected limb broad behind; height of shell 22; breadth 21; diameter 10 mm. U. S. Nat. Mus. Cat. No. 173035.

Type locality.—North coast of Maui Island, Hawaiian Islands, in 143 to 178 fathoms, stony bottom, temperature 60°.8 F., at Bureau of Fisheries station 4079.

Cat. No.	Locality.	Collector.	Number of specimens.
337026	North of Maui, 175 fathoms	B. F	1
173035	North of Maui, 178 fathoms	B. F	Type.
274175	North of Maui, 178 fathoms	B. F	10
173036	North of Maui, 202 fathoms	B. F	1
274174	South of Oahu, 252 fathoms	B. F	1

This fine species was dredged by the U. S. Bureau of Fisheries steamer *Albatross* during the explorations among the Hawaiian Islands.

Genus TEREBRATALIA Beecher.

Terebratalia BEECHER, Trans. Conn. Acad., vol. 9, p. 377, 1873.
Terebratula SOWERBY, Proc. Zool. Soc., 1846, p. 94.
Terebratella (part) ORBIGNY, Pal. Franc. Ter. Crét., vol. 4, p. 110, 1847.

Type.—*T. transversa* Sowerby, Northwest America. Until we know the developmental stages of all our northern species, it seems best to follow Beecher in referring them all to *Terebratalia*.

TEREBRATALIA TRANSVERSA Sowerby.

Terebratula transversa SOWERBY, Proc. Zool. Soc., 1846, p. 94; Thesaurus Conch. *Terebratula*, p. 361, pl. 72, figs. 114, 115, 1847; not of Gould, Otia, p. 120, 1860.

Terebratella transversa REEVE, Conch. Icon. *Terebratula*, pl. 5, fig. 22, 1860.—DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 185.—WHITEAVES, Canadian Nat., new ser., vol. 8, p. 468, 1878.

Terebratella transversa DAVIDSON (ex parte), Mon. Rec. Brach., pt. 2, p. 79, pl. 16, figs. 6–9 (only), 1887.

Terebratalia transversa BEECHER, Trans. Conn. Acad., vol. 9, p. 377, 1893.

Magasella radiata DALL, Rep. Brach. Alaska, p. 49, 1877; Proc. Acad. Nat. Sci. Phila. for 1877, p. 159.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 101, pl. 18, fig. 1, 1887 (immature stage). Shumagin Islands, Alaska.

Type locality.--Puget Sound, Washington.

Cat. No.	Locality.	Collector.	Number of specimens.
224275	Southeast of Alaska Peninsula, 51 fathoms	B. F	2
222395	Southeast of Alaska Peninsula, 68 fathoms	Dall	7
110908	Southeast of Alaska Peninsula, 230 fathoms	Dall	1
110906	Coal Harbor, Shumagins, 9 fathoms	Dall	1 v.
222206	Chignik Bay, Alaska, 28 fathoms	B. F	1
110907	Semidi Ids., Alaska, 20 fathoms	Dall	1
110905	St. Paul, Kodiak, 13 fathoms	Dall	1 v.
55822	St. Paul, Kodiak	Fisher	1
55819	Kodiak Islands	Fisher	23
87852	Kodiak Islands	Fisher	5
209767	Kodiak Islands	Fisher	23
224441	Kodiak Islands	B. F	8
226210	Sumner Strait, 218 fathoms	B. F	1
132966	Fort Wrangell	F. W. Ring	1 v.
73910	Vancouver Island	Hepburn	6
73575	Vancouver Island	Hepburn	1
274177	San Juan Islands	Oldroyd	4
224348a	Puget Sound, 40 fathoms	B. F	15
225461	Puget Sound, 48 fathoms	B. F	4
3368	Puget Sound	Kennerly	2
118583	Puget Sound	O. B. Johnson	2
224350	Puget Sound, 40 fathoms	B. F	4
225439	Puget Sound, 37 fathoms	B. F	6
128764	Seattle, Washington, 20 fathoms	O. B. Johnson	31
130571	Seattle, Washington, l. w	O. B. Johnson	9
226206	Admiralty Inlet, 25 fathoms	B. F	2
222213	Admiralty Inlet	B. F	7
13610	Neeah Bay, Washington	Swan	2
15598	Neeah Bay, Washington	Swan	1 v.
207221	Coast of Washington, 27 fathoms	B. F	1
224392	Coast of Washington, 59 fathoms	B. F	1
225330	Off Sea Lion Rock, 877 fathoms	B. F	1
212830	Off Tillamook, 786 fathoms	B. F	1
104118	Off Crescent City, California	Dall	1 v.
23275	Monterey Bay, California	Dall	1 v.
252994	San Pedro, California	J. J. White	1

Some of the specimens from Kodiak are of a suffused rose color.

TEREBRATALIA TRANSVERSA CAURINA Gould.

Terebratula caurina GOULD, Proc. Boston Soc. Nat. Hist., vol. 3, p. 347, 1850. Exped. Shells, p. 468, pl. 44, fig. 582, 1857; Otia Conch., p. 97, 1862.
Terebratella caurina DALL, Amer. Journ. Conch., vol. 6, p. 119, pl. 6, figs. 1–3, 1870.
Terebratula canrena CARPENTER, Rep. Brit. Assoc., 1856, p. 278.
Terebratella transversa var. *caurina* DAVIDSON, Mon. Rec. Brach., pt. 2, p. 80, pls. 10–12, 14–14*a* (only), 1887.

Type locality.—Puget Sound, U. S. Exploring Expedition.

Cat. No.	Locality.	Collector.	Number of specimens.
110914	St. Paul, Kodiak Island	Dr. Miner	1
110911	Port Etches, Alaska, 8 fathoms	Dall	1
110915	Port Etches, Alaska, 18 fathoms	Dall	3 v.
110909	Port Etches, Alaska, 15 fathoms	Dall	3 v.
110912	Port Etches, Alaska, 15 fathoms	Dall	3
208698	Port Althorp, Alaska, 16 fathoms	Dall	1
11787	Sitka, Alaska, l. w	Dall	14
110910	Sitka, Alaska, 12 fathoms	Dall	1
11785	Sitka, Alaska	Dall	2 v.
110916	Sitka, Alaska, l. w	Bischoff	15
216399	Forrester Id., 20 fathoms	Willett	45
210422	Queen Charlotte Islands	Dawson	2
126636	Victoria, British Columbia	G. W. Taylor	11
110904	Victoria, British Columbia	Richardson	4
222219	Admiralty Inlet, 20 fathoms	B. F.	1
5904	Puget Sound	U. S. Ex.Exp	Type.
15476	Neeah Bay, Washington	Swan	1
224342	Off Alseya River, 46 fathoms	B. F	1
73912	Off Golden Gate, California	Stearns	1
110917	Off Point New Years, California, 16 fathoms	B. F	1
11787	Off San Luis Obispo, California, 21 fathoms	B. F	1
123149	Off Santa Barbara, California, 21 fathoms	B. F	1
123150	Off Santa Barbara, California, 21 fathoms	B. F	3
130402	Off Santa Cruz Island, California, 31 fathoms	B. F	1
253120	Off San Pedro, California	J. J. White	9
133726	Off San Pedro, California		5
128944	Off San Pedro, California	Mearns	1 v.
274178	Off San Pedro, California	Webb	2
274179	Off San Pedro, California	Simpson	3
110918	Off San Pedro, California, breakwater	Stearns	7
129323	Off San Pedro, California	Shepard	24
110919	Off San Pedro, California	Oldroyd	1
254084	Off San Pedro, California	Bryant	4
253820	Off San Pedro, California	Bryant	6
110770	Off Southern California, 26 fathoms	B. F	1 v.
73911	Off San Diego, California	Hemphill	1
211952	Off San Diego, California, 20 fathoms	B. F	1 yo.
110886	Off San Diego, California, kelp roots	Hemphill	2 yo.
110920	Off San Thome, Lower California	Hemphill	1 yo.

The typical *transversa* which is smooth or nearly so, grows to a much greater size than the wide strongly ribbed *caurina*, which is on the whole more southern in distribution. The former is generally of a grayish color, the latter tends to reddish.

TEREBRATALIA CAURINA RUBESCENS Dall.

Terebratalia transversa rubescens DALL, Nautilus, vol. 24, No. 8, Dec. 1910, p. 96.

Type locality.—San Pedro, California.

Cat. No.	Locality.	Collector.	Number of specimens.
110887	Monterey, Cal	Dall	1
253820a	San Pedro, Cal	Bryant	Type.

TEREBRATALIA OCCIDENTALIS Dall.

Terebratella occidentalis DALL, Proc. Cal. Acad. Sci., vol. 4, p. 182, pl. 1, fig. 7. 1871; Proc. Acad. Nat. Sci. Phila. for 1891, pp. 172–3, pl. 4, figs. 8–9, (not 6–7 as indicated in the explanation of the plates).

Terebratella transversa DAVIDSON, Mon. Rec. Brach., pt. 2, p. 79 (in synonymy), pl. 16, fig. 13 (only), 1887, not of Sowerby.

Type locality.—Off San Clemente Island, California.

Cat. No.	Locality.	Collector.	Number of specimens.
130563	San Pedro, California	Oldroyd	2 yo.
110783	Off Anacapa Island, California, 46 fathoms	B. F.	1
95850	Off San Clemente Island, 45 fathoms	B. F.	1
123144	Cortez Bank, 47 fathoms	B. F.	1 v.

This species resembles the variety *rubescens* of *T. transversa* in color, but is much more inflated, sometimes white, with red color only on the ribs, but may be instantly distinguished from any of the forms of *transversa* by the fact that its mesial fold is directly opposite to that of any of them, the sulcus being in the pedicel valve while in *transversa* it is in the brachial valve. It was confused by Davidson with the red variety of *transversa*.

After a study of the variations in plication observed in this and other species of Terebratelloids of the North Pacific, I conclude that too high a systematic value has been placed on the various modifications, in this group at least, by some excellent students of the brachiopoda.

TEREBRATALIA OBSOLETA Dall.

Terebratella occidentalis, var *obsoleta* DALL, Proc. U. S. Nat. Mus., vol. 14, p. 186, 1891.

Terebratalia obsoleta DALL, Trans. Conn. Acad., vol. 9, p. 382, pl. 2, figs. 4–12; pl. 3, figs. 1–15, March, 1893; Proc. U. S. Nat. Mus., vol. 17, p. 726, pl. 30, fig. 7, 1895.

Dallinella obsoleta J. ALLAN THOMSON, Geol. Mag., dec. 6, vol. 2, No. 607, p. 75, Jan. 1915.

Type locality.—Northwest of Cerros Island, Lower California, in 58 fathoms, bottom temperature 50° 8 F. at United States Fish Commission station 2983.

Cat. No.	Locality.	Collector.	Number of specimens.
110972	Catalina Island, California, 50 fathoms	Lowe	4
122545	Off Cerros Island, Lower California, 113 fathoms	B. F.	1
123141	Off Cerros Island, Lower California, 58 fathoms	B. F.	13+
123142	Northwest of Cerros Island, Lower California, 113 fathoms	B. F.	7+
123143	Off Point Abreojos, Lower California, 58 fathoms	B. F.	20
123140	Off Point Abreojos, Lower California, 58 fathoms	B. F.	23

The plus mark stands for many young specimens of various ages in addition to the counted adults. Comparing the incongruity of the types of plication with other characters of the species concerned, it does not seem to me to have any serious systematic value in the group of recent forms here under consideration. I am not able to accept the compliment which Doctor Thomson has graciously conferred upon me in proposing on that basis a new genus for the *T. obsoleta*.

It differs from the other species of the coast in its thin and delicate polished shell which contrasts strongly with the solid dull-surfaced character of the others; its brilliant scarlet painting is equalled only by such species as *Laqueus pictus* and *Frenulina sanguinolenta*. In the completely adult there is on either side of the narrow deltidia a flattened area with a keeled edge. Beecher's diagram (pl. 3, fig. 15) of the loop is good but does not indicate the fact that the cardinal plate is divided to the apex of the valve where there is a thin wide cardinal process. A completely adult specimen measured 39 mm. high, 42 mm. wide, and has a diameter of 21 mm. It exhibits the wildest variations in plication from a barely preceptible protractive arcuation of the anterior edge of the pedicel valve to a very strong squarish ridge with four or five minor denticulations, to a ribbed form with ten or twelve subequal modifications of the margin. There is in the pedicel valve a very low slender septal median keel in the hollow of the beak which terminates in a short broad low ridge with an excavated top. There are small props to the hinge teeth from which in senile specimens an arcuate raised line runs down into the dome of the valve. In *T. transversa* the props are almost obsolete and stop short behind the teeth; in the completely adult there is a low flattish septal ridge extending beyond the middle of the pedicel valve and forked at its anterior extremity. In fairly adult *T. caurina* I find no trace of this ridge. In both there is a wide thin cardinal process and nothing resembling a cardinal plate between the dental

sockets. In both the flattened areas on the outer sides of the deltidia are wide and conspicuous.

TEREBRATALIA FRONTALIS Middendorff.

Terebratula frontalis MIDDENDORFF, Beitr. Mal. Rossica, pt. 3, p. 2, 1849; Sibirische Reise, pt. 2. p. 241, pl. 18, figs. 9–14, 1851.

Terebratella frontalis DALL, Amer. Journ. Conch., vol. 6, p. 123, 1870.—DAVIDSON, Mon. Rec. Brach, pt. 2, p. 86, pl. 15, figs. 1–8*a*., 1887.

Diestothyris frontalis ALLAN THOMSON, Geol. Mag., dec. 6, vol. 3, p. 504, 1916.

?*Magasella aleutica* DALL, Proc. Cal. Acad. Sci., vol. 4, p. 302, pl. 1, fig. 6, 1872 (immature stage); Proc. Acad. Nat. Sci. Phila. for 1873, p. 188.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 95, pl. 17, figs. 16–17*b*., 1887.

Type locality.—South coast of the Okhotsk Sea.

Cat. No.	Locality.	Collector.	Number of specimens.
210934	Bering Island, 15 fathoms	Grebnitsky	20
223494	Bering Island, 10 fathoms	Grebnitsky	2
110797	Southeast coast Sakhalin Island, 64 fathoms	B. F	1
175783	Shikotan, Chishima, Japan	Hirasé	4
273092	Shikotan, Chishima, Japan	Hirasé	4
110798	Japan Sea, 122 fathoms	B. F	1
271435	Kuril Islands	Sowerby	2
110974	Attu Island, Aleutians, 7 fathoms	Dall	2 yo.
110976	Attu Island, Aleutians, 18 fathoms	Dall	4
110980	Attu Island, Aleutians, 5 fathoms	Dall	25
110973	Nazan Bay, Atka Island, 14 fathoms	Dall	1
225481	Nazan Bay, Atka Island, 14 fathoms	Dall	5
110972	Korovin Bay, Atka Island, 14 fathoms	Dall	1
110977	Nazan Bay, Atka Island, 14 fathoms	Dall	11
110975	Nazan Bay, Atka Island, 14 fathoms	Dall	5
110979	Port Etches, Alaska, 15 fathoms	Dall	4 v.

MAGASELLA ALEUTICA.

207256	Bering Island	B. F	1
133568	Alaska	Dall	2
110939	Kyska Harbor	Dall	1
110941	Kyska Harbor, 10 fathoms	Dall	2
110943	Kyska Harbor, beach	Dall	1
110940	Kyska Small Pass, 10 fathoms	Dall	1
110942	Kyska Great Pass, 10 fathoms	Dall	4
110946	Adakh Island, beach	Dall	1
110944	Nazan Bay, Atka Island, l. w	Dall	2
110945	Nazan Bay, Atka Island, l. w	Dall	1
33801	Unalashka Island, 60 fathoms	Dall	1
224002	Unalashka Island, 60 fathoms	Dall	1
110947	Chika Islands, beach	Dall	4
110948	Coal Harbor, Unga Island, 4 fathoms	Dall	4
223227	Popoff Strait	Dall	1
110938	Popoff Strait, l. w	Dall	[1] 6
33802	Little Koniushi Island	Dall	1
110949	Simeonoff Island	Dall	6 v.
331748	British Columbia, 238 fathoms	B. F	2

[1] Types.

Notwithstanding the fact that *Magasella aleutica* is neatly shaped and prettily colored while *Terebratalia frontalis* is dull gray, coarse and usually misshapen, I am pretty well satisfied that the former should be referred to the immature stage of the latter.

T. frontalis has an enormous pedicel opening with inconspicuous widely separated deltidia, no septal ridge in the pedicel valve, short props to the dental processes and the faintest possible indication of a protractive fold on the anterior edge of the valve; the brachial valve has a small cardinal process, there is a narrow platform with a concavely arcuate anterior edge between the crural ridges; instead of a septum a sharp groove starts from under the platform in the cavity of the beak and extends beyond the middle of the valve where a low short triangular septum, much farther forward than usual, rises out of the groove to support the loop. Davidson's figures show the crural plates entirely separated but this is not the case with my specimens. The muscular impressions are more widely separated than in the other species of the group. Upon these characters Allan Thomson has separated this species generically from *Terebratalia*.

TEREBRATALIA GOULDII Dall.

Terebratella gouldii DALL, Proc. Acad. Nat. Sci. Phila., for 1891, p. 167, pl. 4, figs. 4, 5.

?*Magasella gouldii* DALL, Proc. Zool. Soc., 1871, p. 307, pl. 31, figs. 11 *a–c*.—DAVIDSON, Proc. Zool. Soc., 1887, p. 96, pl. 17, figs. 20–22 (immature stage). Hakodate, W. Stimpson.

Type locality.—East coast of Japan between Yedo and Oshima. F. Stearns.

Cat. No.	Locality.	Collector.	Number of specimens.
107712	Japan Sea on *Antipathes*	Ward	1
107713	Gulf of Tokio, 169 fathoms	B. F.	4
208675	Gulf of Tokio, 169 fathoms	B. F.	6
204662	Off Honshu Island, 259 fathoms	B. F.	1
204663	Off Hondo, 259 fathoms	B. F.	1

I am not so sure that the *Terebratalia* is the adult of the above-mentioned *Magasella* as I was at first, but in any case the specific name holds for the former. This species is thin with a weak hinge, a well marked "collar" within the foramen and no septal ridge; the teeth are normally propped. In the brachial valve there is a feebly developed cardinal process, the crural ridges are not united mesially, a very short low septum, almost entirely behind the muscular impressions which are very adjacent, receives the attachment of the loop some 5 millimeters in front of the beak in a specimen 28 millimeters high. In front of the septum are two short diverging raised lines about

4 millimeters long which form the inner boundaries of the muscular scars. There is an extremely faint depression medially in the pedicel valve but no other indication of folding.

TEREBRATALIA COREANICA Adams and Reeve.

Terebratula coreanica ADAMS and REEVE, Voy. *Samarang*, Moll., p. 71, pl. 21, fig. 3, 1850.—REEVE, Conch. Icon. *Terebratula*, pl. 7, fig. 28 *a–b*, 1861.

Terebratella coreanica DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9,p. 367, 1852.—SCHRENCK, Amurl. Moll., p. 468, pl. 18, fig. 7, 1867.

Terebratella miniata GOULD, Proc. Boston, Soc. Nat. Hist., vol. 7, p. 323, 1861; Otia Conch., p. 120, 1862.

Terebratella coreanica DAVIDSON, Proc. Zool. Soc., 1871, p. 304, pl. 31, figs. 4–5; Mon. Rec. Brach., pt. 2, p. 81, pl. 13, figs. 3–7, 1887.

? *Terebratella bouchardi* DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 367, 1852; Proc. Zool. Soc., 1852, p. 77, pl. 14, figs. 4–6; Mon. Rec. Brach., pt. 1, pl. 13, figs. 8–9, 1886.

Type locality.—Korean Archipelago.

Cat. No.	Locality.	Collector.	Number of specimens.
274180	Hakodate, Japan	Morse	20
274181	Hakodate, Japan	Morse	20 yo.
107730	Hakodate Bay, 12 fathoms	B. F.	1
110970	Hakodate Bay, 15 fathoms	B. F.	1
110976	Hakodate Bay, 44 fathoms	B. F.	2
110971	Kamihama Tanfo	B. F.	1
204671	Off Hondo, 88 fathoms	B. F.	1 var. *b*.
110795	Off Ando Zaki, 80 fathoms	B. F.	1
110785	Japan Sea, 47 fathoms	B. F.	1
204670	Off Korea, 150 fathoms	B. F.	1 var. *b*.
111084	Gulf of Tartary	Morse	1
183384	Tsingtao, China	Hammerstein	1 v.

This beautiful species grows to be nearly the largest of recent brachiopods and in form one of the most regular. In color it varies from a suffused rose color, to the variety *miniata* Gould, which is yellowish, painted with radial streaks of red. The oval form which Davidson described as *T. bouchardi* (var. *b*.) occurs rarely among the specimens I have seen. The shell figured in the atlas to the voyage of La Perouse by Lamanon, and which was called *lamanoni* by Schrenck in 1867, is not perhaps identifiable with anything, certainly not with the present species whose arched back could hardly have been ignored by the draughtsman, as it is characteristic of even the youngest specimens, and is responsible for the deep median sulcus of the pedicel valve. The foramen is large and the rugose deltidia not coalescent, sometimes meeting, and sometimes the gap between them is filled by an irregular calcareous plug. The teeth are strong, the props reduced to a pinpoint dimple in a mass of callus in the adults. There is a low ridge bifurcate anteriorly between the mus-

cular scars but not extending into the beak, nor attaining the proportions of a septum. The interior of the valve is marked by numerous radiating, bifurcating shallow furrows. The brachial valve is medially provided with a broad depression and produced to occupy the sulcus in the opposite valve; there is a strong bifurcate cardinal process; the sockets are not cross-striated; there is a thick mass of callus bridging the gap between the stems of the crura; the loop extends nearly to the anterior edge of the valve. In this valve also a thick low ridge, grooved medially, extends from the callous mass between the crura forward between the thickened muscular scars. Out of the groove rises a very low thin short septum, the junction with the cross band of the loop is little elevated and slightly behind the middle of the valve. The interior of this valve is furrowed like the other valve. The shell is solid and tends to form callosities with age. It reaches a width of 53, a height of 52, and a diameter of 32 mm.

TEREBRATALIA XANTHICA, new species.

Shell bright yellowish-brown, transverse, inflated, smooth except for feeble incremental lines, the brachial valve feebly mesially excavated, but showing hardly any undulation at the anterior edge. The deltidia are coalescent in the young, widely separated in the adult, the adult foramen large, showing no "collar;" the props to the dental plates obsolete, no septum or mesial ridge between the muscular scars, and two short vermicular genital sinuses on each side.

Brachial valve with no cardinal process, the crural stems separated to the apex, a short wide loop with a low short septum amd one genital sinus on each side. A young specimen which appears to be of the same species, however, has the crural stems united by a concave platform continuous with the posterior end of the septum which divides the space beneath the platform into two cavities. Height of shell, 25; width, 33; diameter, 19 mm.

Type locality.—Japan Sea in 86 fathoms, sand, at United States Bureau of Fisheries station 4996.

Cat. No.	Locality.	Collector.	Number of specimens.
206783	Japan Sea, 86 fathoms	B. F.	Type.
110797	Souheast coast Sakhalin Island, 64 fathoms	B. F.	1
111081	Hakodate, Japan	Morse	2

This species presented something of a puzzle, and at first I was disposed to regard it as an extreme variation of *T. coreanica*, but on careful study the differences appeared so great that I concluded to place it separately. The transverse form, the absence of the broad

plication of the pedicel valve with the prominent sulcus found in *T. coreanica;* the widely divided crura and the absence of any marked cardinal process and other features appear to justify its separation, even if we ignore the conspicuous difference in color.

The species appears to be intermediate in general between the smooth form of *T. transversa* and *T. coreanica.*

TEREBRATALIA MARIAE A. Adams.

Terebratella mariae A. ADAMS, Ann. Mag. N. Hist., ser. 3, vol. 5. p. 412, 1860. vol 11, p. 99, 1863.—DAVIDSON, Proc. Zool. Soc., 1871, p. 305 pl. 30, figs; 15–17.—DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 1854.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 89, pl. 15, figs. 13, 14, 1887.

Type locality.—Uraga, Japan, in 21 fathoms. A. Adams.

Cat. No.	Locality.	Collector.	Number of specimens.
110793	Korea Strait, 59 fathoms	B. F.	1v.

This was collected at U. S. Bureau of Fisheries station 4895, in 59 fathoms, sandy bottom.

TEREBRATALIA SPITZBERGENSIS Davidson.

Terebratella spitzbergensis DAVIDSON, Proc. Zool. Soc., 1852, p. 78; Ann. Mag. Nat. Hist., ser. 2, vol. 16, p. 442, pl. 10, fig. 3, 1855; Proc. Zool. Soc., 1871, p. 305, pl. 30, fig. 13.—JEFFREYS, Proc. Zool. Soc. 1878, p. 409, pl. 23, fig. 2.—FRIELE, Arch. f. Math. og Naturvid., p. 384, pl. 6, figs. 1, 2, 1877.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 83, pl. 16, figs. 1–5, 1887.

Cat. No.	Locality.	Collector.	Number of specimens.
173605	Figured British Conch V, pl. 8, fig. 1	Jeffreys	2
173603	Spitsbergen	Torell	1
173604	Shetland Islands	Jeffreys	1
173607	Arctic Sea	Belcher	2
173603	Greenland	McLain	2
110934	Off Hare Island, 90 fathoms	McLain	3
173608	Off Hare Island	*Valorous* Exp.	2
173612	Off Hare Island	*Valorous* Exp.	1
173840	Off Disco, 175 fathoms	*Valorous* Exp.	1
173609	Off Disco	Jeffreys	2
336908	Hebron, Labrador	O. Bryant	1
110935	Gulf of St. Lawrence	Whiteaves	5
173602	Murray Bay, Quebec	Dawson	3

This interesting little species appears to be rare.

Genus LAQUEUS Dall.

Laqueus DALL, Amer. Journ. Conch., vol. 6, p. 123, 1870; Bull. U. S. Nat. Mus., No. 8, p. 41, 1877.—DAVIDSON, Mon. Rec. Brach., vol. 2, p. 111, 1887. Type *L. californicus* Carpenter, not Koch=*L. erythraeus* Dall.

LAQUEUS CALIFORNICUS Koch.

Terebratula californica Koch, in Chemnitz, Conch. Cab., ed. 2, *Terebratula*, p. 38, pl. 2*b*, figs. 21–23, 1848.—Sowerby, Thes. Conch., p. 352, pl. 70, figs. 50–51 (not 52), 1847.

Terebratula kochii Küster, Chemnitz Conch. Cab., ed. 2, *Terebratula*, p. 39, pl. 2*d*, figs. 1–3, 1848.

Terebratula californiana Davidson, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 364, 1852.

Waldheimia californica Gray, Brit. Mus. Cat. Brach., p. 60, 1853.

Laqueus californicus Dall (ex parte) Amer. Journ. Conch., vol. 6, p. 123, 1870.—Davidson, Mon. Rec. Brach., pt. 2, p. 112, pl. 18, figs. 6–9, 1887.

Frenula jeffreysi Dall (ex parte) Amer. Nat., vol. 5, p. 55, 1871.

Ismenia jeffreysi Dall (ex parte) Amer. Journ. Conch., vol 7, p. 65, pl. 11, figs. 7–10, 1887.

Megerlia jeffreysi Dall, Proc. Acad. Nat. Sci. Phila. for 1873, p. 187.

Laqueus californicus var. *vancouveriensis* Davidson, Mon. Rec. Brach., pt. 2, p. 113, pl. 18, figs. 10–13*b*, 1887.

Type locality.—California.

L. CALIFORNICUS, typical.

Cat. No.	Locality.	Collector.	Number of specimens.
110928*a*	British Columbia, 238 fathoms	B. F.	1
331750	British Columbia, 238 fathoms	B. F.	2
123146	Off Point Arena, California, 75 fathoms	B. F.	4
225731	Off Point Pinos, California, 861 fathoms	B. F.	Fr.
123145	Off Esteros Bay, California, 92 fathoms	B. F.	11
226350	Off Esteros Bay, California, 92 fathoms	B. F.	3
212556	Off Esteros Bay, California, 92 fathoms	B. F.	10
206476	Off Central California, 92 fathoms	B. F.	8
160165	Off San Pedro, California 50–75 fathoms	Oldroyd	2 yo.
209539	Off La Jolla, California 199 fathoms	B. F.	Fr.
209970	Off Point Loma, California, 113 fathoms	B. F.	Fr.

L. CALIFORNICUS VANCOUVERIENSIS.

Cat. No.	Locality.	Collector.	Number of specimens.
224274	South East Alaska Peninsula, 51 fathoms	B. F.	12
222394	South East Alaska Peniusula, 68 fathoms	B. F.	5
222597	Chignik Bay, 60 fathoms	B. F.	1
222217	Chignik Bay, 42 fathoms	B. F.	1
123147	Shumagin Banks, 138 fathoms	B. F.	5
206477	Semidi Islands., 20 fathoms	Dall	1
226355	Kodiak Island	Fisher	2
55821	Kodiak Island	Fisher	1
206475	Kodiak Island	Fisher	2
110444	Kodiak Island., 51 fathoms	B. F.	4
222180	Shelikoff Strait, 56 fathoms	B. F.	8
110931	Port Etches, 18 fathoms	Dall	2
110933	Port Etches, 18 fathoms	Dall	7 v.
110929	Port Etches, 15 fathoms	Dall	8 v.
110930	Port Etches, 15 fathoms	Dall	1
210043	Juneau Harbor	Ritter	2
222291	Lynn Canal, 300 fathoms	B. F.	2
222201	Sumner Strait, 200 fathoms	B. F.	2
222150	Kasa-an Bay, 96 fathoms	B. F.	4
222197	Kasa-an Bay, 95 fathoms	B. F.	4

Cat. No.	Locality.	Collector.	Number of specimens.
226229	Stephens Passage, 188 fathoms	B. F	1
226213	Stephens Passage, 200 fathoms	B. F	2
222152	Off Naha Bay, 65 fathoms	B. F	2
222129	Off Naha Bay, 175 fathoms	B. F	3
222149	Boca de Quadra, 165 fathoms	B. F	4
216400	Forrester Island., 75 fathoms	B. F	6
226427	Queen Charlotte Islands, 107 fathoms	B. F	1
222203	Queen Charlotte Islands, 140 fathoms	B. F	3
110927	Off British Columbia, 238 fathoms	B. F	15
110928	Off British Columbia, 238 fathoms	B. F	15
331750	Off British Columbia, 238 fathoms	B. F	2
110928*a*	Off British Columbia, 238 fathoms	B. F	1
222200	Gulf of Georgia, 190 fathoms	B. F	1
206478	Victoria, British Columbia	Richardson	1
110978	Victoria, British Columbia	Richardson	1
224484	Fuca Straits, 135 fathoms	B. F	9
224369	Fuca Straits, 100 fathoms	B. F	7
207173	Fuca Straits, 59 fathoms	B. F	1
130416	Fuca Straits, 56 fathoms	B. F	1
224424	Fuca Straits, 40 fathoms	B. F	3
224532	Fuca Straits, 114 fathoms	B. F	2
224569	Fuca Straits, 115 fathoms	B. F	2
224533	Fuca Straits, 124 fathoms	B. F	2
206724	Fuca Straits, 152 fathoms	B. F	1
223229	Fuca Straits, 151 fathoms	B. F	13
118584	Puget Sound	O. B. Johnson	1
224349	Puget Sound, 40 fathoms	B. F	5
224391	Washington coast, 59 fathoms	B. F	1
224390	Washington coast, 66 fathoms	B. F	1
225328	Washington coast	B. F	1
208639	Washington coast, 66 fathoms	B. F	1
214339	Off Tatoosh Island, 115 fathoms	B. F	2

Küster figures the typical form, which is white more or less obscured by a pale grayish periostracum, sometimes darkening to brown. I have some doubts whether the *T. kochii* of Küster, referred by Davidson to this species as a synonym, is identical. It suggests to me a discolored specimen of *T. venosa* Solander. I have never seen a specimen of the present species which agrees with Küster's figure. Sowerby figures a *Magellania* loop (fig. 32) which he, of course wrongly, refers to this species, and Reeve follows him under the name of *T. globosa* Lamarck. It is uncertain whether this is due to faulty drawing or to confusion with *T. venosa*. Carpenter identified *L. erythraeus* with this species and I followed him, but present studies have enabled me to correct this identification.

In 1871 before Friele had made clear the modification of the loop in the course of growth I confounded shells in the analogous stages of *Macandrevia cranium* and the present species under the common name of *Frenula jeffreysi*. As I referred my species in my first announcement to the North Atlantic fauna, it follows that that name must be regarded as a synonym of *M. cranium*, and for the northern

and generally smaller variety of *L. californicus* Mr. Davidson's name of *vancouveriensis* must be used.

The extreme variations in form of the variety *vancouveriensis* are very puzzling. Some of the specimens so nearly approach the *L. morsei* that it is only the presence of absolute gradations between them and the more usual ovate type that decides one to keep them distinct. Some specimens have a faint indication of uniplication in the brachial valve, others have the front edge straight but pinched together mesially as in *L. blanfordi* with a suggestion of bilobation, others again are frankly lenticular. Such differences in the same species throw doubt on the value of plication in these recent forms as a systematic character. The genital sinuses are threadlike and produced nearly to the front margin of the valves.

LAQUEUS ERYTHRAEUS, new species.

Terebratula californica CARPENTER, Suppl. Rep. Brit. Assoc., pp. 568, 574, 1864. Not of Koch, 1848.

Waldheimia californica CARPENTER, Suppl. Rep. Brit. Assoc., p. 636, 1864.[1]

Laqueus californicus DALL, Amer. Journ. Conch., vol. 6, p. 123, pl. 7, fig. f; pl. 8, figs. 9, 10, 1870.

Type locality.—Off Catalina Island, California, in 80 fathoms. J. G. Cooper.

Cat. No.	Locality.	Collector.	Number of specimens.
19395	Catalina Island, 80 fathoms	Cooper	1
1023	Catalina Island, 120 fathoms	Cooper	Fr.
253007	Catalina Island, 50 fathoms	Paine	2
253113	Catalina Island, 50 fathoms	Lowe	3
128793	Catalina Island, 32 fathoms	Oldroyd	1
110921	Catalina Island, 50 fathoms	Oldroyd	5
149961	Catalina Island	Button	2
193755	California	S. F. Price	1

This shell is of a lovely red color, evenly suffused. It is thin and usually larger than the *L. californicus* from which it can be immediately separated by the broad heavy genital sinuses, visible through the shell, with short wide lateral branches, recalling those of *Magellania venosa.*

LAQUEUS BLANFORDI Dunker.

Terebratula blanfordi DUNKER, Index Moll. Maris Japonici, p. 251, pl. 14, figs. 4, 5, 6, 1882.

Terebratella blanfordi DAVIDSON, Mon. Rec. Brach., pt. 2, p. 83, pl. 15, figs. 9–12, 1887.

Type locality.—Near Wakayama, Japan.

[1] The *Waldheimia grayi* of Carpenter's list on this page is the red variety of *Terebratalia caurina* Gould, and his *Terebratella coreanica* is a reddish mutation of *Terebratalia transversa* Sowerby. Both *grayi* and *coreanica* are Asiatic species.

Cat. No.	Locality.	Collector.	Number of specimens.
110801	Off Avacha Bay, Kamtchatka, 682 fathoms	B. F	15
110799	Japan	Fulton	2
110803	Kagoshima Gulf, 103 fathoms	B. F	1
110804	Sagami Bay, 369 fathoms	B. F	1
110802	Japan Sea, 190 fathoms	B. F	7
204661	Japan Sea, 390 fathoms	B. F	1
204664	Uraga Straits, 85 fathoms	B. F	2
204665	Suruga Gulf, 57 fathoms	B. F	1 v.
204666	Suruga Gulf, 131 fathoms	B. F	1
110847	Off Honshu Island, 265 fathoms	B. F	1
110805	Gulf of Tokio, 70 fathoms	B. F	3
107732	Gulf of Tokio, 169 fathoms	B. F	1

This species is remarkable for its variations in form. The originally described form was almost bilobate, pinched together in the median line; from this it varies to squarely truncate or even with the truncation prominent anteriorly. From rounded triangular it varies to ovate or even nearly circular, but always with the anterior truncation. Some specimens show a feeble "dorsal uniplication," others have a marked depression medially in the brachial valve, and the most normal or typical show a pinching together of both valves in the median line with more or less bilobation. In the pedicel valve the teeth are strong, with well marked props which have a callous concave area between them, with no median ridge, but two widely separated low ridges which extend two-thirds of the way to the anterior edge of the valve; in the the brachial valve there is a moderate cardinal process, the crural stems are united by a concave platform supported medially by a strong septum separating the cavity below into two parts. The septum in front of the platform is thin, moderately high and extends forward less than one-third the length of the valve, the apex where the cross band of the loop is attached is about 4 millimeters in front of the tips of the crura, in a specimen 40 millimeters long. The color is always brownish.

LAQUEUS MORSEI Dall.

Laqueus morsei Dall, Nautilus, vol. 22, No. 3, July, 1908, p. 29.

Type locality.—Japan Sea in 122 fathoms, stony mud bottom, temperature 34.1° F., at Bureau of Fisheries station 4860.

Cat. No.	Locality.	Collector.	Number of specimens.
110800	Japan Sea, 122 fathams	B. F	3

This is of much the same type as *L. blanfordi* but larger, more inflated and with an anterior projection of the margin instead of the straight truncation visible in those varieties of *blanfordi* which have not a medial sulcus. There is an extremely faint indication of a convex undulation at the front edge of the pedicel valve.

The interior of the pedicel valve is much like that of *L. blanfordi* with three conspicuous genital sinuses on each side, rather broad and bifurcating near the margin. The brachial valve has an even shorter septum than *blanfordi,* with two straight unbranched sinuses medially and one on each side with about four lateral branches which bifurcate near the margin. There is a hardly distinguishable cardinal process. The deltidia are coalescent medially, and more or less wrinkled.

LAQUEUS RUBELLUS Sowerby.

Terebratula rubella SOWERBY, Proc. Zool. Soc., 1846, p. 94; Thes. Conch., p. 350, pl. 69, figs. 40–42, 1847.

Terebratella rubella DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 368, 1852.—GRAY, Cat. Brach. Brit. Mus., p. 90, 1853.

Laqueus rubella DAVIDSON, Proc. Zool. Soc., 1871, p. 306, pl. 30, figs. 18–22.—DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 186.

Laqueus rubellus DAVIDSON, Mon. Rec. Brach., pt. 2, p. 113, pl. 19, figs. 1–5, 1887.

Type locality.—Japan. Compare:

Anomia picta DILLWYN, Desc. Cat. Rec. Sh., vol. 1, p. 295, 1817, after Chemnitz; Conch. Cab., vol. 11, p. 247, pl. 203, figs. 2011, 2012, 1795.

Terebratula picta ANTON, Verz., p. 23, No. 891, 1839.—SOWERBY, Thes. Conch., p. 361, *Terebratula*, pl. 70, figs. 43, 44, 1847.—KÜSTER, in Chemn. Conch. Cab., ed. 2, *Terebratula*, p. 41, pl. 2 c., figs. 8, 9, 1868.

Waldheimia picta GRAY, Cat. Brach. Brit. Mus., p. 59, 1853.

Laqueus pictus DAVIDSON, Mon. Rec. Brach., pt. 2, p. 114, pl. 18, figs. 14–18, 1887.

Type locality.—Off Satanomosaki, Japan, in 55 fathoms. Arthur Adams.

Cat. No.	Locality.	Collector.	Number of specimens.
110809	Kagoshima, Japan	B. F.	1
110810	Kagoshima, Japan, 58 fathoms	B. F.	21
204681	Kagoshima, Japan	B. F.	2 yo.
204680	Kagoshima, Japan, 70 fathoms	B. F.	2
110982	Japan Sea, 47 fathoms	B. F.	1
274182	Japan Sea, 45 fathoms	B. F.	Many yo.
211077	Japan Sea, 44 fathoms	B. F.	Many yo.
204684	Off Cape Tsiuki, 44 fathoms	B. F.	1
204686	Off Cape Tsiuki, 44 fathoms	B. F.	2
204682	Off Cape Tsiuki, 47 fathoms	B. F.	1
204683	Off Hondo, 63 fathoms	B. F.	2
110082	Off Hakodate	Morse	1
110813	Off Hakodate, 47 fathoms	B. F.	10
274183	Off Hakodate	Morse	9
226188	Off Hakodate, 44 fathoms	B. F.	1
193634	Off Honshu Island, 55 fathoms	B. F.	2
110812	Off Honshu Island, 60 fathoms	B. F.	2

Cat. No.	Locality.	Collector.	Number of specimens.
110781	Off Honshu Island, 65 fathoms	B. F	19
110737	Off Oze Zaki, 65 fathoms	B. F	1
206802	Suruga Gulf, 100 fathoms	B. F	1
124224	Jogoshima	F. Stearns	2
107728	Jogoshima	F. Stearns	1
130158	Japan	Herman	1
75107	Enosima	Jouy	2
274184	Tanaba, Kii	Hirasé	2
110811	Eastern Sea, 53 fathoms	B. F	2
110807	Eastern Sea, 139 fathoms	B. F	1
110806	Pailolo Channel, Hawaii	B. F	1

I have not seen any specimens of the typical *pictus* with the divaricating irregular coloration, but I strongly suspect that *L. rubellus* Sowerby may be identical with it. The known range is the same. Davidson states that *rubellus* is distinguished from *pictus* by "its straight or slightly indented front." He also says that the colors in the figure given by Sowerby in the Thesaurus are exaggerated. I have numerous specimens as bright as Sowerby's figure, and while the front edge usually shows straight, there is sufficient variation to enable one to find numerous individuals of *rubellus* with a rounded front. However, I have no typical specimens of *pictus* and therefore I refrain from uniting them, but the question is worthy of careful examination. As far as I have been able to discover, Dillwyn was the first to give validity to Chemnitz' name.

LAQUEUS SUFFUSUS Dall.

Laqueus suffusus Dall, Amer. Journ. Conch., vol. 6, p. 125, pl. 7, figs. *g*, *h*, *s*, 1870.
Laqueus pictus junior? Davidson, Mon. Rec. Brach., pt. 2, p. 114, pl. 19, figs. 6, 7 *b*., 1887.
Waldheimia cranium A. Adams, Ann. Mag. Nat. Hist., ser. 3, vol. 11, p. 98, 1863. Not of Müller, 1776.

Type locality.—Wharf at Yokohama, Japan. R. Pumpelly.

Cat. No.	Locality.	Collector.	Number of specimens.
11784	Yokohama, Japan	Pumpelly	22
274185	Hakodate, Japan	Morse	25
226193	Hakodate, Japan, 44 fathoms	B. F	1
110808	Korea Strait, 59 fathoms	B. F	1

When I described this species I had no specimens of *L. rubellus* for comparison, and yielded to the opinion of Mr. Davidson, that it was a pale variety of *L. rubellus*, or as he afterwards concluded of *L.*

pictus. Now that I have a large series of both for comparison, I return to my earlier opinion and believe the two to be quite distinct specifically. Adult *suffusus* is about one-third the length of adult *rubellus* and is mainly of a pale gray color, with a very faint suffusion of red about the margin. The surface is dull, while *rubellus* in fresh state is polished, and it is impossible to believe that so expert a naturalist as Arthur Adams would have confounded the brightly colored *rubellus* with *Macandrevia cranium.*

Genus MACANDREVIA King.

Macandrevia KING, Proc. Dublin Univ. Zool. Bot. Assoc., vol. 1, p. 261, 1859, not of Gray, 1860.—DALL, Bull. U. S. Nat. Mus., No. 8, p. 45, 1877; Bull. Mus. Comp. Zool., vol. 43, No. 6, p. 444, 1908. Type, *Terebratula cranium* Müller.

MACANDREVIA CRANIUM Müller.

Terebratula cranium MÜLLER, Prodr. Zool. Dan., p. 249, No. 3006, 1776.—SOWERBY, Thes. Conch., *Terebratula*, p. 354, pl. 70, figs. 60–62, 1847.—DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 16, pl. 10, fig. 8, 1855.

Terebratula euthyra PHILIPPI, En. Moll. Sicil., vol. 2, p. 68, pl. 18, fig. 8, 1844 (according to Davidson).

Terebratula glabra LEACH, Syn. Moll. Gt. Brit., p. 359, pl. 13, figs. 3, 4, 5, 1852.

Waldheimia cranium GRAY, Cat. Brach. Brit. Mus., p. 58, 1853.—DALL, Amer. Journ. Conch., vol. 6, p. 110, 1870.—FRIELE, Arch. for Math. og Naturv., 1877, p. 380, pls. 1, 2, 3, figs. 1–4, 7*a*, 8–11.—G. O. SARS, Moll. Reg. Arct. Norv., p. 10, pl. 1, figs. 3 *a–c*, 1878.

Macandrevia cranium KING, Proc. Dublin Univ. Zool. Bot. Assoc., vol. 1, p. 261, 1859.—DALL, Bull. U. S. Nat. Mus. No. 8, p. 45, 1877.

Waldheimia (*Macandrevia*) *cranium* DAVIDSON, Mon. Rec. Brach., vol. 2, p. 61, pl. 12, figs. 11–23; pl. 13, figs. 1, 2, 1887.

Frenula jeffreysi (ex parte) DALL, Amer. Nat., vol. 5, p. 55, 1871.

Type locality.—Coast of Norway. Müller.

Cat. No.	Locality.	Collector.	Number of specimens.
75808	North Europe	Carpenter	1
110877	North Atlantic	Friele	5
110876	North Atlantic, 345 fathoms	Jeffreys	6
274186	Finmark	Jeffreys	1
109673	Finmark	G. O. Sars	2
11890	Norway	McAndrew	4
109666	Norway	McAndrew	1
110880	Norway	McAndrew	3
109667	Norway, 60 fathoms	McAndrew	1
25525	Norway	M. Sars	6
109663	Norway	Osbiornsen	9
109662	Norway, Osterfiord	Jeffreys	1
109664	Norway	Friele	1
109665	Norway	Friele	2
109668	Norway	Koren	2
109669	Norway	Norman	3
109670	Norway	Jeffreys	3
109671	Drobak, Norway, 305 fathoms	Jeffreys	1
109672	Vallö, Norway, 50 fathoms	G. O. Sars	2

Cat. No.	Locality.	Collector.	Number of specimens.
109676	Bodö, Norway, 1 fathom	G. O. Sars	18
109800	Bodö, Norway, 50 fathoms	G. O. Sars	1
25524	Lofoten Ids., 26 fathoms	G. O. Sars	2
109674	Lofoten Ids., 54 fathoms	G. O. Sars	2
109675	Bohuslan, Sweden	Malm	1
109652	Unst, Shetlands, 170 fathoms	Jeffreys	3
109653	Unst, Shetlands	Jeffreys	20
109654	Unst, Shetlands	Jeffreys	1
109655	Unst, Shetlands	Jeffreys	3
109656	Unsthaf, Shetlands	Jeffreys	3
109657	Unsthaf, Shetlands	Jeffreys	11
109658	St. Magnus Bay, Shetlands	Jeffreys	1
109659	St. Magnus Bay, Shetlands, 90 fathoms	Jeffreys	1
109660	Zetland	Jeffreys	1
109661	Zetland	Jeffreys	7
109677	N. of Scotland, 632 fathoms	*Porcupine* Exp	6
109678	N. of Scotland, 114 fathoms	*Porcupine* Exp	3½
109679	N. of Scotland, 345 fathoms	*Porcupine* Exp	5½
109680	N. of Scotland, 203 fathoms	*Porcupine* Exp	Lot.
109681	N. of Scotland, 250 fathoms	*Porcupine* Exp	14
109682	N. of Scotland, 290 fathoms	*Porcupine* Exp	Lot.
109683	N. of Scotland, 190 fathoms	*Porcupine* Exp	3
109684	N. of Scotland, 362 fathoms	*Porcupine* Exp	8
109685	N. of Scotland, 155 fathoms	*Porcupine* Exp	5
109688	N. W. of Ireland, 164 fathoms	*Porcupine* Exp	3
109689	N. W. of Ireland, 420 fathoms	*Porcupine* Exp	2
109686	West of Ireland, 173 fathoms	*Porcupine* Exp	1
130328	North of Spain, 277 fathoms	*Travailleur* Exp	2
109687	Off Cape Finisterre, 567 fathoms	*Porcupine* Exp	5
109690	Off Cape Finisterre	*Porcupine* Exp	1
109691	Off Cape Finisterre	*Porcupine* Exp	2
109692	Off Cape Finisterre, 690 fathoms	*Porcupine* Exp	1
109693	Vigo Bay, Spain, 30 fathoms	*Porcupine* Exp	1
109694	Vigo Bay, Spain, 60 fathoms	McAndrew	1
109695	W. of Portugal, 292 fathoms	*Porcupine* Exp	4
109697	S. of Sicily, 224 fathoms	*Porcupine* Exp	1
109698	E. coast Greenland, 108 fathoms	Jeffreys	Frag.
110878	Developmental series	Friele	Many.
110879	Developmental series	Friele	Many.
109645-48	Developmental series	Friele	Many.
109644	Showing loop	*Porcupine* Exp	......
109651	Showing loop	Carpenter	1
109643	(Monstrosity)	Jeffreys	1
109650	Fleming's type	Jeffreys	1
109649	Young shells	Jeffreys	1
109642	Fig'd specimens Brit. Conch., vol. 5, pl. 19,	Jeffreys	......

MACANDREVIA CRANIUM, new var. NOVANGLIAE.

50668	Southeast Georges Banks, 1,149 fathoms	B. F	1 v.
78069	Off Marthas Vineyard, 137 fathoms	B. F	1
78340	East of Nantucket, 1,188 fathoms	B. F	1
49068	East of Block Island, 1,178 fathoms	B. F	5

The American specimens which have been referred to *M. cranium* are all of very uniform size, much smaller than the European speci-

mens and less inflated, the anterior truncation relatively wider. Comparative dimensions, in millimeters, are as follows:

M. cranium: Height, 23; width, 18; diameter, 18.
M. novangliae: Height, 15; width, 13; diameter, 8.

Type locality.—U. S. Fish Commission station 2682 off Marthas Vineyard, in 137 fathoms, green mud, bottom temperature 47.5° F.

In other respects the variety agrees fairly well with the European form.

Another variety, *oblonga*, is noted by Jeffreys in his collection, in which the shell is elongated and narrow, though still symmetrical; but this hardly exceeds the mutation to be observed in any large collection of a species of brachiopod. The type of this variety is No. 274186, from Finmark, but there are a number of other specimens among those catalogued under the general designation of *M. cranium.*

MACANDREVIA TENERA Jeffreys.

Terebratula tenera JEFFREYS, Ann. Mag. Nat. Hist., ser. 4, vol. 18, p. 250, 1876, Proc. Zool. Soc. 1878, p. 405, pl. 22, fig. 7.

Waldheimia (Macandrevia) tenera DAVIDSON, Mon. Rec. Brach., pt. 2, p. 66, pl. 12, figs. 6–10, 1887.

Type locality.—Latitude 56° 11′ N.; longitude 37° 41′ W., south of Greenland in the north Atlantic, in 1,450 fathoms, Valorous Expedition.

Cat. No.	Locality.	Collector.	Number of specimens.
109799	North Atlantic, 1,450 fathoms	Jeffreys	Many v.

MACANDREVIA CRANIELLA Dall.

Macandrevia craniella DALL, Proc. U. S. Nat. Mus., vol. 17, p. 722, pl. 30, fig. 1, 1895; Bull. Mus. Comp. Zool., vol. 43, No. 6, p. 445, 1908.

Type locality.—U. S. Bureau of Fisheries station 3362, off Cocos Island, Gulf of Panama, in 1,175 fathoms, mud, bottom temperature 36.8° F. One specimen.

It somewhat resembles *Waldheimia wyvilli* Davidson, but is larger, more solid, and wants the medial septum in the brachial valve.

MACANDREVIA AMERICANA Dall.

Eudesia fontaineana DALL, Proc. U. S. Nat. Mus., vol. 12, p. 231, 1889; not of Orbigny, 1846.

Macandrevia americana DALL, Proc. U. S. Nat. Mus., vol. 17, p. 721, pl. 32, figs. 1, 4, 7, 1895; Bull. Mus. Comp. Zool., vol. 43, No. 6, p. 444, 1908.

Type locality.—U. S. Bureau of Fisheries station 2783, off the coast of southern Chile, in 122 fathoms, mud, bottom temperature 48° F.

Cat. No.	Locality.	Collector.	Number of specimens.
122859	Gulf of Panama, 1,672 fathoms	B. F	1
110744	Off Aguja Point, Peru, 2,222 fathoms	B. F	1
110794	Coast of Chile, 122 fathoms	B. F	1
87547	Coast of Chile, 122 fathoms	B. F	1
265902	South-southwest of San Diego, California, 1,090 fathoms.	B. F	11
274180	Off San Diego, California, 868 fathoms	B. F	2

The specimens from near San Diego are much less lenticular than the original type, more inflated, and more or less truncate in front, otherwise similar. They might perhaps be regarded as a variety *diegensis*.

MACANDREVIA DIAMANTINA Dall.

Macandrevia diamantina DALL, Proc. U. S. Nat. Mus., vol. 17, p. 723, pl. 30, fig. 5, pl. 32, figs. 3, 6, 1895; Bull. Mus. Comp. Zool., vol. 43, No. 6, p. 445, 1908.—J. ALLAN THOMSON, Austr. Antarctic Exp., *Brachiopoda*, p. 34, 1918.—J. WILFRID JACKSON, Scot. Ant. Exp., Brach., p. 379, pl. 2, figs. 15–19, 1912.

Type locality.—U. S. Bureau of Fisheries station 3362, off Cocos Island, Gulf of Panama, in 1,175 fathoms, mud, bottom temperature 36.8° F.

Cat. No.	Locality.	Collector.	Number of specimens.
122860	Off Cocos Island, 1,175 fathoms	B. F	1
223627	Off Cocos Island, 1,175 fathoms	B. F	2
110743	Off Sechura Point, Peru, 2,222 fathoms	B. F	1
274170	Off Coats Land, 1,410 fathoms	Scot. Ant. Exp	2

The wide range of this species is notable. The props to the crural plates are less conspicuous than in the other species. They curve down toward the middle line of the cavity of the beak, where they are separated by a narrow furrow. There is a conspicuous cardinal process, which is wanting in the other species of the genus.

Genus DALLINA Beecher.

Dallina BEECHER, Trans. Conn. Acad., vol. 9, p. 382, March, 1893, type, *Terebratula septigera* Lovèn.

DALLINA SEPTIGERA Lovèn.

Terebratula septigera LOVÈN, Index Moll. Scand., p. 29, 1846.

Waldheimia septigera GRAY, Cat. Brach. Brit. Mus., p. 59, 1852.—DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 16, p. 441, pl. 10, fig. 1, 1855.—SEGUENZA, Mem. d. Soc. Ital. Sci. Nat., vol. 1, p. 44, pl. 6, figs. 1–10, 1855.—DALL, Bull. Mus. Comp. Zool., vol. 3, p. 13, pl. 1, fig. 4; pl. 2, fig. 9, 1871.—FRIELE, Arch. Math. og Naturvid., vol. 2, p. 380, pl. 3, figs. 5, 6; pl. 4, figs. 12–14, 1877.

Terebratula peloritana SEGUENZA, Notiz. Succ., p. 19, 1862.
Terebratula septata JEFFREYS, Brit. Conch., vol. 2, p. 14, 1863; not of Philippi, 1844.
Terebratula floridana JEFFREYS, Proc. Zool. Soc., 1879, p. 407; not of Pourtalès, 1868.
Waldheimia septigera DAVIDSON, Mon. Rec. Brach, pt. 1, p. 56, pl. 11, figs. 1-10, 1886.
Dallina septigera BEECHER, Trans. Conn. Acad., vol. 9, p. 382, 1893.

Type locality.—Finmark, Norway, Lovèn.

Cat. No.	Locality.	Collector.	Number of specimens.
109779	Norway	Lovèn	1
109795	Bergen, Norway	Friele	4
109793	Havsbron, Norway, 120 fathoms	G. O. Sars	1
109794	North Sea	Lovèn	2
109792	North Sea	Jeffreys	4
109771	North of Scotland, 345 fathoms	*Porcupine* Exp	15
109772	North of Scotland	*Porcupine* Exp	2
109773	North of Scotland	*Porcupine* Exp	10
109774	North of Scotland	*Porcupine* Exp	2
109775	North of Scotland, 250 fathoms	*Porcupine* Exp	1
109776	North of Scotland	*Porcupine* Exp	2
109777	Mull, Zetland	*Porcupine* Exp	12
109778	Shetlands	Jeffreys	8
109780	Northwest of Ireland	*Porcupine* Exp	3
109781	Southwest of Ireland	*Porcupine* Exp	3
110862	North Atlantic, 345 fathoms	*Porcupine* Exp	4
109782	West of Cape Finistére	*Porcupine* Exp	3
109784	West of Cape Finistére	*Porcupine* Exp	1
109783	West of Cape Finistére, 567 fathoms	*Porcupine* Exp	2
130329	Bay of Biscay, 277 fathoms	*Travailleur* Exp	2
109785	Bay of Biscay, 277 fathoms	*Porcupine* Exp	Frag.
109786	West of Portugal	*Porcupine* Exp	6

This was confused by Jeffreys with *Terebratula septata* Philippi, on account of superficial similarity, but by careful methods Seguenza was able to show that the latter species was not even congeneric. The external characters of many brachiopods are so similar that only an examination of the interior characters suffices to reveal their true relations.

DALLINA FLORIDANA Pourtalès.

Waldheimia floridana POURTALÈS, Bull. Mus. Comp. Zool., vol. 1, p. 127, 1868.—DALL, Bull. Mus. Comp. Zool., vol. 3, p. 12, pl. 1, fig. 3; pl. 2, figs. 1, 2, 3, 1871.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 59, pl. 12, figs. 1-5, 1887.
Dallina floridana BEECHER, Trans. Conn. Acad., vol. 9, p. 382, pl. 1, fig. 45, 1893.

Type locality.—Off the Florida reefs between 100 and 200 fathoms, rocky bottom. Pourtalès.

Cat. No.	Locality.	Collector.	Number of specimens.
110861	Gulf Stream, 200 fathoms	Pourtales	6
110863	Gulf Stream, 150 fathoms	Pourtales	6
110860	Off Fernandina, Florida, 270 fathoms	B. F	1 v.
110858	Florida Keys	Str. *Fishhawk*	5
110859	Florida Keys	Str. *Fishhawk*	9
274188	Off Sand Kay, 115 fathoms	Henderson	1 v.
274189	Off the Sambos, 120 fathoms	Henderson	5
274190	Off the Sambos, 135 fathoms	Henderson	2
274191	Off the Sambos, 118 fathoms	Henderson	1
274192	Off the Western dry reefs, 144 fathoms	Henderson	1
107527	Off Key West, 90 fathoms	Nutting	3
173495	Gulf of Florida	Pourtales	3
173494	Gulf of Mexico	A. Agassiz	5
173496	Gulf of Mexico	A. Agassiz	1
64256	Off Bahia Honda, Cuba, 310 fathoms	*Blake*	1
226291	Mayaguez Harbor, Porto Rico, 224 fathoms	B. F	2

This like the other species of *Dallina* has a pedicel valve with a depression mesially, terminating in a protractive arcuation of the anterior margin, and two more or less obvious depressions in the brachial valve, with a medial low convexity between them or, as it has been called, "dorsal biplication." There are no props to the dental plates nor septum in the pedicel valve, the foramen is entire; in the brachial valve there is a platform between the stems of the crura supported by a prominent medial septum. The cardinal process is short, wide, and feeble.

There is more or less variation in relative width and strength of plication, but on the whole the species is very constant in its characters.

DALLINA RAPHAELIS Dall.

Waldheimia raphaelis Dall, Amer. Journ. Conch., vol. 6, p. 111, pl. 7, figs. *a–e*, 1870.—Davidson, Proc. Zool. Soc., 1871, p. 303, pl. 31, fig. 9; Mon. Rec. Brach., pt. 1, p. 58, pl. 11, figs. 11-13, 1886.

Dallina raphaelis Beecher, Trans. Conn. Acad., vol. 9, p. 382, 1893.

Type locality.—Japanese coast near Yeddo; Raphael Pumpelly. Also the variety was found by Döderlein in Sagami Bay, in 100 to 200 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
110845	Near Yeddo	Pumpelly	Type.
110846	Japan	Ward	1
110792	Kagoshima Gulf, 105 fathoms	B. F	1

DALLINA RAPHAELIS ALBIDA, new variety.

110784	Off Honshiu Island, 45 fathoms.	B. F.

The type and other specimens originally described are of a rather dark warm brown but one lot of specimens obtained by the Bureau of Fisheries steamer *Albatross* is pure white and the contrast is so well marked that a varietal name seems appropriate. There is a median coil to the brachia and the cardinal process is inconspicuous. Davidson's figures 11*a–c* seem to be taken from a specimen of the variety and figures 12 and 13 from the typical forms of the species.

PEREUDESIA, new subgenus.

This differs from *Magellania* by the incomplete foramen, broad hinge area, and the presence of props to the hinge teeth in the pedicel valve. It differs from *Eudesia* by its incomplete foramen and broad hinge area, and from both by the heavy coarse structure of the shell.

Type.—*Terebratula grayi* Davidson.

PEREUDESIA GRAYI Davidson.

Terebratula grayi DAVIDSON, Proc. Zool. Soc., 1852, p. 76, pl. 4, figs. 1–3.

Terebratula (*Waldheimia*) *grayi* SCHRENCK, Reisen in Amurl., p. 465, 1856.—REEVE, Conch. Icon. *Terebratula*, pl. 2, figs. 5 *a–c*, 1860; Journ. de Conchyl., vol. 9, p. 123, 1861.

Waldheimia grayi DAVIDSON, Mon. Rec. Brach., pt. 1, p. 54, pl. 10, figs. 1–3, 1886. Not of Carpenter, Suppl. Rep. Brit. Assoc., p. 636, 1864.

W. grayi var. *transversa* DAVIDSON, Mon. Rec. Brach., pt. 1, pl. 10, figs. 4, 4*a–b*, 1886.

?*Magasella gouldii* DALL, in Davidson, Proc. Zool. Soc., 871, p. 307, pl. 21, figs. 11*a–c*.

Type locality.—Korea Strait in 37 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
1651	Hakodate Bay, Japan	Stimpson	4
111080	Hakodate Bay, Japan	Morse	3
274195	Hakodate Bay, Japan	Morse	Many yo.
274194	Japan	Morse	12
110884	Japan	F. Stearns	2
274193	Hirado, Hizen, Japan	Hirasé	3
162575	Hirado, Hizen, Japan	Hirasé	3
274196	Otaru, Japan	Morse	4 yo.
274197	Matsushima, Japan	Morse	2

No. 110884 represents Davidson's variety *transversa*, which externally is exactly like the red transverse variety of *Terebratalia caurina* Gould, and the two were confounded by Cooper and Carpenter in their early reports on the mollusca of the northwest coast. *P. grayi* does not occur in the latter region, though formerly reported from there, owing to the above-mentioned confusion. The cardinal process is very short wide and transversely rugose. The shell is ventrally uniplicate like *T. caurina*.

Subfamily MAGELLANIINAE.

Genus MAGELLANIA Bayle.

Magellania BAYLE, Journ. de Conchyl., vol. 28, p. 240, 1880; new name for *Waldheimia* King, Perm. fos., pp. 81, 145, 1850; not *Waldheimia* Borelle, 1846, Insecta.

Type.—Terebratula flavescens Lamarck.

MAGELLANIA FLAVESCENS Lamarck.

Terebratula flavescens LAMARCK, Anim. s. Vert., vol. 6, p. 246, 1819.—REEVE, Conch. Icon., *Terebratula*, pl. 1, pl. 2, figs. 1 *a–b*, 1860.

Terebratula dentata LAMARCK, Anim. s. Vert., vol. 6, p. 246, 1819.

Terebratula australis QUOY and GAIMARD, Voy. *Astrolabe*, Zool., p. 551, pl. 85, figs. 1–5, 1834.—SOWERBY, Thes. Conch. *Terebratula*, p. 349, pl. 69, figs. 25–33, 1847.

Terebratula recurva QUOY and GAIMARD, Voy. *Astrolabe*, Zool., p. 554, pl. 85, figs. 10–11, 1834.—SOWERBY, Thes. Conch. *Terebratula*, p. 350, pl. 69, figs. 34–36, 1847.

Terebratula incurva DAVIDSON, Mon. Rec. Brach., pt. 1, p. 41, 1886, in synonymy.

Waldheimia australis KING, Perm. foss., p. 145, pl. 20, figs. 10–12, 1850.—HANCOCK, Philos. Trans. Royal Soc., vol. 148, p. 791, 1858.

Waldheimia flavescens DAVIDSON, Brit. foss. Brach., pt. 1, p. 64, figs. 6 and 7, 1853.—DALL, Amer. Journ. Conch., vol. 6, p. 108, figs. 5–9, 1870.—DOUVILLÉ, Bull. Soc. Geol. de France, ser. 3, vol. 7, p. 25, fig. 13, 1879.—DAVIDSON, *Challenger* Brach., p. 41, pl. 3, figs. 10–12, 1880; Mon. Rec. Brach., pt. 1, p. 41, pl. 7, figs. 6–19, text figs. 3–8, 1886.

Terebratula spadae ARADAS, Atti Accad. Gioenia, vol. 4, 1847, p. 107, 1847; (exotic specimen erroneously reported from Sicily).

Type locality.—Java, according to the book, but Davidson states that Valenciennes who wrote the diagnosis for the then blind Lamarck, asserted that the specimen came from Port Jackson, South Australia, which is probably correct. The specimen supposed to come from Sicily and described by Aradas, was undoubtedly exotic. According to Tenison Woods the species is abundant on the south Australian coast but in Tasmania occurs only on the northern shore.

Cat. No.	Locality.	Collector.	Number of specimens.
17814	Australia	U. S. Expl. Exp.	4
11892	Australia	Damon	4
110881	Australia	Dall	2
77275	Australia	Dr. Stearns	2
274200	South Australia	Bednall	3
64337	South Australia	Dr. Stearns	2 yo.
75927	Sydney, New South Wales	Cox	6
76411	Fort Jackson	Beadle	2
274198	Spencer Gulf	S. Smith	3
274199	Victoria, Australia, 6–11 fathoms	Hanshaw	3
173493	Moreton Bay	Flower	1
102042	Tasman Strait	Dr. Stearns	1
110882	Southern Chile	U. S. Expl. Exp.	2

The young of this species are often smooth but can always be distinguished from the young of *M. kerguelenensis* by the entire foramen and produced beak. In the latter species the foramen is open from the beginning and the beak in the adult less produced and much more incurved than in *M. flavescens*. There is often some uncertainty as to the accuracy of the localities for the shells of the United States Exploring Expedition, for reasons I have explained elsewhere, so some doubt attaches to the specimens of undoubted *M. flavescens* labeled from Patagonia, now southern Chile, above cited.

MAGELLANIA KERGUELENENSIS Davidson.

Waldheimia kerguelensis DAVIDSON, Proc. Royal Soc., vol. 27, p. 437, 1878 (err. typ.); *Challenger* Brach., pl. 3, figs. 1–9, 1880.

Waldheimia kerguelenensis DAVIDSON, *Challenger* Brach., p. 40, 1880; Mon. Rec. Brach., pt. 1, p. 53, pl. 10, figs. 7–17, 1886.

? *Terebratula globosa* SOWERBY, Thes. Conch. *Terebratula*, pl. 71, figs. 99–101, 1847; cf. Davidson, Chall. Brach., p. 41.

Type locality.—Kerguelen Islands., *Challenger* Expedition.

Cat. No.	Locality.	Collector.	Number of specimens.
110803	Off Kerguelen, 150 fathoms....................	Sowerby...........	1

MAGELLANIA JOUBINI Blochmann.

Magellania joubini BLOCHMANN, Zool. Anz., vol. 30, p. 677, 1906.

Type locality.—Near the winter quarters of the Gauss Antarctic Expedition in 209 fathoms.

Three young specimens (Cat. No. 110440) were received from Blochmann, who thinks that the young brachiopod collected by the Belgica Expedition in latitude 80° W. and figured by Joubin in his report on the brachiopoda (pl. 2, figs. 16, 17) in 1902, is identical, thus indicating that the species is circumpolar.

In this connection it may be mentioned that among the shells sent by Colonel Turton from Saint Helena Island was a young *Magellania* (Cat. No. 124859) of indeterminable species, but naturally resembling the very young of *M. joubini*.

Subgenus NEOTHYRIS Douvillé.

Neothyris DOUVILLÉ, Bull. Soc. Géol. de France, sér. 3, vol. 7, p. 277, 1879.

MAGELLANIA (NEOTHYRIS) VENOSA Solander.

Anomia venosa SOLANDER, Portland Cat., p. 166, No. 3609, 1786 (name only); Dixon's Voy., p. 355, pl. 11, fig. 3, 1789.

Anomia caput-serpentis SOLANDER, in Mus. Calonnianum, p. 45, in synonymy; 1797, not of Linnaeus, 1758.

Terebratula sp., BRUGUIÈRE, Encycl. Méth., vol. 1, pl. 239, fig. 2, 1798.

Terebratula globosa LAMARCK, An. s. Vert., vol. 6, p. 246, 1819.

Terebratula dilatata LAMARCK, An. s. Vert., vol. 6, p. 245, 1819.

Terebratula gaudichaudi BLAINVILLE, Dict. Sci. Nat., vol. 53, p. 136, 1828; not of Gray, Griffith's Cuvier, vol. 12, p. 132, pl. 4, figs. 2, 2*a*, 1833 (=*T. lenticularis* Deshayes).

Terebratula globosa BLAINVILLE, Malac., pl. 52, fig. 2, 1826.—REEVE, Conch. Icon., *Terebratula*, pl. 2, figs, 3*a–c*, 1860; pl. 6, figs. 3*d–c*, 1861.

Terebratula dilatata REEVE, Conch. Icon., *Terebratula*, pl. 2, figs. 2, 1860; pl. 6, figs. 2*b*, 2*c*, 1861.

Terebratula physema VALENCIENNES, in Reeve, Conch, Icon., *Terebratula*, pl. 6, figs. 23*a–c*, 1861.

Waldheimia venosa DAVIDSON, Ann. Mag. Nat. Hist., ser. 3, vol. 8, p. 36, 1861.—DALL, Amer. Journ. Conch., vol. 6, p. 109, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 182.—DAVIDSON, Mon. Rec. Brach., pt. 1, p. 49, pl. 8, figs. 1–6, 1886.

Terebratula eximia PHILIPPI, in Conch. Cab., ed. 2, *Terebratula*, p. 39, pl. 2*d*., figs. 9, 10, 1843.

Terebratula fontaineana ORBIGNY, Voy. Amer. Mér., vol. 5, p. 675, pl. 85, figs. 30, 31, 1847.

Terebratula pulvinata GOULD, Proc. Boston Soc. Nat. Hist., vol. 3, p. 347, Dec. 1850; U. S. Expl. Exped., Shells, p. 468, pl. 44, fig. 581, 1857.

Waldheimia pulvinata GOULD, emend., Otia Conch., p. 97, 1862.

Terebratella pulvinata CARPENTER, Checklist West Coast shells, p. 1, 1860.—DALL, Amer. Journ. Conch., vol. 6, pt. 2, p. 117, 1870 (young shell in *Terebratella* stage).

Magasella laevis DALL, Amer. Journ. Conch., vol. 6, pt. 2, p. 136, pl. 6, figs. 9, 10, 13, 1870 (young in *Magasella* stage).

? *Terebratula malvinae* ORBIGNY, Voy. Am. Mér., vol. 5, p. 674, pl. 85, figs. 27–29, 1846 (*Magasella* stage).

Type locality.—Falkland Islands.

Cat. No.	Locality.	Collector.	Number of specimens.
5963 [1]	Patagonia	U. S. Expl. Exped.	2
11782 [2]	Patagonia	U. S. Expl. Exped.	2
17813	Orange Harbor, Patagonia	U. S. Expl. Exped.	7
110922	Orange Harbor, Patagonia	Dall	7
96201	Magellan Strait, 20 fathoms	B. F	2
110923	Magellan Strait, 51 fathoms	B. F	2
110924	Magellan Strait, 61 fathoms	B. F	9
110925	Magellan Strait, 61 fathoms	B. F	5

[1] Types of *T. pulvinata* Gould. [2] Types of *Magasella laevis* Dall.

This species ranges from Coquimbo, Chile, to the Straits of Magellan and the Falkland Islands.

There is an interesting succession indicated, beginning with the Tertiary *Terebratella tehuelca* of von Ihering, from the Cape Fairweather beds, for which he proposed the generic name *Pachymagas*, and which retains the terebratelliform loop until of a very large size, but finally loses it and proceeds to a point where its cardinalia and adjacent parts and cardinal process are loaded thickly with callous deposits. The beak is also much prolonged and the foramen quite

entire. This is followed by *T. lenticularis* Deshayes, in which the loop becomes free from the septum much sooner, the beak is lower and the callous deposits in the adult, though exactly analogous to those of the fossil, are less abundant and crude; and finally the present species in which the beak is still lower and in some old specimens the foramen is not entirely closed, the loop becomes free of the septum at a still earlier stage, and the cardinalia never attain the callosified condition of its predecessors. I conclude from this that *T. venosa*, though *lenticularis* survives, is the newer development of the two. I suspect that the shell figured by Reeve as the original *dilatata* of Lamarck, which always has a large incomplete foramen and more transverse form, is a distinct species.

MAGELLANIA (NEOTHYRIS) LENTICULARIS Deshayes.

Terebratula lenticularis DESHAYES Revue Zool. Soc. Cuvierienne, May, 1839, p. 359.—GUERIN, Mag. de Zool. for 1841, pl. 45.—SOWERBY, Thes. Conch., *Terebratula*, p. 360, pl. 41, figs. 108–110, 1847.—REEVE, Conch. Icon., *Terebratula*, pl. 2, fig. 4, 1860.

Terebratula gaudichaudii GRAY, in Griffith's Cuvier, pl. 4, fig. 2, 1833; not of Blainville, 1828.

Waldheimia lenticularis GRAY, Cat. Brach. Brit. Mus., p. 58, 1853.—DALL, Proc. Acad. Nat. Sci. Phila., for 1873, p. 182.—DAVIDSON, Mon. Rec. Brach., pt. 1, p. 52, pl. 9, figs. 2–13, 1886.

Neothyris lenticularis DOUVILLÉ, Bull. Soc. Géol. de France, ser. 3, vol. 7, p. 26, 1880.—J. ALLAN THOMSON, Austr. Antarctic Exp., *Brachiopoda*, p. 25, 1918.

Type locality.—Foveau Straits, New Zealand.

Cat. No.	Locality.	Collector.	Number of specimens.
107729	New Zealand	Ward	1
110926	Bluff Harbor, New Zealand	Dr. Kershner	5
195288	Stewart Island, New Zealand, 18 fathoms.	Suter	2
332783	New Zealand	Fulton	3

The prominent large tridentate cardinal process of this species is a conspicuous feature. It is the type of the subgenus *Neothyris*.

Genus CAMPAGES Hedley.

Campages HEDLEY, Records Austr. Museum, vol. 6, pt. 2, p. 43, figs. 5, 6, Sept. 1905, type, *C. furcifera* Hedley.

Type locality.—East of Cape Byron, New South Wales, in 111 fathoms.

CAMPAGES FURCIFERA Hedley.

Campages furcifera HEDLEY, Records Austr. Museum, vol. 6, pt. 2, p. 43, figs, 5, 6, Sept. 1905.

Type locality.—East of Cape Byron, New South Wales, in 111 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
335704	Gabo Island, New South Wales, 115 fathoms	Hedley.............	1
333010	Gabo Island, New South Wales, 145 fathoms	Hedley.............	2

Externally exactly like *Gryphus fulva* Blochmann, the specimens agree with Hedley's figure of *Campages furcifera*, but have only a feeble anterior fold to the valves, and a longer, narrower, and less funicular loop.

CAMPAGES ASTHENIA, new species.

Shell whitish, rather inflated, subrectangular and moderately elongated, smooth except for lines of growth; punctation conspicuous; beak large, foramen entire, the deltidia completely coalescent with a small ridge medially; hinge teeth strong, short, quite closely adjacent, without props; there is no "collar" or medial ridge in the valve, which anteriorly is squarely prominent as in *C. furcifera* but less emphatically so; two obscure ridges extend back over the valve from the shallow notches at the sides of the prominence; there is a small cardinal process, the cardinalia and loop resemble those of *C. furcifera;* the septum extends forward as far as the anterior extremity of the loop. Height of shell 21; breadth 15; diameter 10 mm.

Type locality.—U. S. Bureau of Fisheries station 5172, off Jolo, Philippines, in 318 fathoms, sand; one specimen and a fragment.

Cat. No.	Locality.	Collector.	Number of specimens.
111061	Off Jolo, Philippines, 318 fms..................	B. F................	Type.
299785	Sibuko Bay, Borneo, 347 fms..................	B. F................	2 v.

This agrees in its characters with *C. furcifera* but is less arcuate, has a much feebler fold, and the anterior part of the loop is less elevated.

CAMPAGES BASILANICA, new species.

Shell small, shaped much like *Megerlia willemoesi* Davidson, yellowish white, smooth, with conspicuous punctation, rather solid for its size, inflated; pedicel valve with a short stout beak, complete foramen, narrow inconspicuous deltidia, short slender hinge teeth rather close together, no props, "collar," or septum; the fold comprising a wide sulcus on either side of a small low-arched prominence; the sides of the valve prominently arcuate; brachial valve with undivided cardinal platform very short and concave, the loop large for the size of the shell, formed as in *C. furcifera* but without lateral

perforations, the septum extends as far forward as the loop; genital sinuses in two small reticulate groups on each side of the posterior half of the pedicel valve. Height of shell 14.0; breadth 11.0; diameter 10.5 mm.

Type locality.—Kagoshima Gulf, Japan, in 103 fathoms.

Cat. No.	Locality.	Collector.	Number of specimens.
204667	Kagoshima Gulf, 103 fathoms	B. F.	1
110546	Japan Sea, 361 fathoms	B. F.	1
204668	Korea Strait, 59 fathoms	B. F.	1
297610	Balabac Island, Philippine Islands, 68 fathoms.	B. F.	1
236595	Off Basilan, Philippine Islands, 78 fathoms	B. F.	1
299438	Tawitawi Islands, Philippine Islands, 240 fathoms.	B. F.	1
294719	Off North Burias, Philippine Islands, 105 fathoms.	B. F.	2
111060	Off North Burias, Philippine Islands, 105 fathoms.	B. F.	1
294621	Off Jolo, Philippine Islands, 161 fathoms	B. F.	3
295880	Off West Luzon, Philippine Islands, 170 fathoms.	B. F.	2
300322	Off Celebes, 700 fathoms	B. F.	1
296886	Off Pratas Island, China Sea, 122 fathoms	B. F.	1 v.
297041	Off Pratas Island, China Sea, 230 fathoms	B. F.	6 v.
296726	Off Pratas Island, China Sea, 150 fathoms	B. F.	1 v.

This externally resembles *T. mariae* A. Adams but is folded in the contrary direction.

CAMPAGES (JOLONICA) HEDLEYI, new species.

Shell subcircular, smooth except for lines of growth, with minute, not very dense punctation, of a whitish color and rather delicate structure; pedicel valve with a rather short beak and entire foramen, short and slender deltidia, strong hinge teeth rather close together and supported by their props with ample cavities between them and the shell wall; there is a feeble "collar" and a very short but distinct septal ridge ending anteriorly in a small knob from which two shallow divergent furrows extend forward nearly to the anterior edge of the valve; there is a very slight squarish depression anteriorly to receive a corresponding prominence from the brachial valve; the latter is subcircular with a small distinct rugose concave cardinal process; the cardinal plate is divided clear to the apex of the valve, the dental sockets are deep and the inner lamina curved over so as to make the socket resemble a split tube from which the teeth of the other valve can not be disengaged without fracture; there is a groove between the laminae and the stem of the crura which are short and widely triangular, the lower limb of the loop continuous with the upper limb; the sharp rather high septum extends from

below the cardinal process to the middle of the valve, ceasing abruptly; there is a deep squarish notch in the posterior edge of the upper limb of the loop, and below this the opening which usually exists in this place is entirely closed by a calcareous plate, while the distal ends of the lower limbs of the loop project as two small unattached points about 2 millimeters long. Height of the shell 18.0; breadth 18.0; diameter 9.5 mm. U. S. Nat. Mus. Cat. No. 111059.

Type locality.—U. S. Bureau of Fisheries station 5172, off Jolo, Philippines, in 318 fathoms, sand; one specimen and a fragment.

I have some hesitation in referring this species to *Campages* on account of the props in the pedicel valve (which Hedley does not refer to and are presumably absent in the *C. furcifera*), the divided cardinal plate and the projecting spurs of the lower part of the loop. Otherwise the resemblance is close. The closed aperture I presume is due to coalescence of spicules, but this demands more material to determine. Meanwhile attention may be called to its peculiarities by regarding it as a section of the genus. The specimen described was dead when dredged but retained the loop uninjured.

CAMPAGES JAFFAËNSIS

Magasella jaffaënsis Blochmann, Trans. Royal Soc. of South Australia, vol. 34, p. 92, pl. 27, figs. 6–9, 1910.

Campages jaffaënsis Hedley, Zool. Results Ex. F. I. S. *Endeavor*, pt. 1, p. 114, pl. 20, figs. 41–42, 1911.—Allan Thomson, Geol. Mag., dec. 6, vol. 3, p. 500, Nov. 1916.

Type locality.—Cape Jaffa, South Australia, in 90 fathoms. Doctor Verco.

Cat. No.	Locality.	Collector.	Number of specimens.
214306	Beachport, South Australia, 150 fathoms......	Verco...............	3

There is no doubt this should be included in *Campages.*

Genus MAGASELLA Dall.

Magasella Dall, Amer. Journ. Conch., vol. 6, p. 134, 1870.

Type.—*Terebratula flexuosa* King. Magellan Straits.

The type upon which this group was originally based was supposed to be *Terebratella evansi* Davidson, 1852. A recent study of the material upon which my original diagnosis was based shows that the specimens really belong to the *T. flexuosa* of King, 1831.

The confusion which reigned in the period just previous to and somewhat after the epoch-making discovery of Friele, in regard to the changes which take place in the form of the loop, during the development of the Terebratelloid brachiopods, was very great and affected all our synonymy.

It was not at first understood that certain species stopped short in their development at particular stages while others reaching that stage continued their evolution. In fact the confusion, or perhaps it would be better to say the doubtful points, are not yet entirely cleared up.

Our series of *Terebratella dorsata* is quite small and perhaps should not form the basis of any dogmatic opinion, but from the material which has passed through my hands I feel confident that *T. flexuosa* King is distinct, adult, and not a stage of *T. dorsata*, as it has been sometimes regarded. In this opinion I am supported by the views of Davidson and Ihering.

On the other hand *T. evansi* and *T. valenciennesi*, of which I have never seen authentic specimens, are admitted by Davidson and the majority of writers to be developmental stages of *T. dorsata* or some other similar species.

Still another form, which by some authors is regarded as a mutation of *T. dorsata*, seems distinct, as I have already indicated under the head of *T. sowerbii* King.

In 1891.[1] I indicated the probable relations of the various small species of *Magasella* then known, and not much can be added even now, to that statement. The few species of doubtful relations will here be considered separately.

MAGASELLA FLEXUOSA King.

Terebratula flexuosa KING, Zool. Journal, vol. 6, p. 337, 1831.—SOWERBY, Thes. Conch., vol. 1, p. 347, pl. 69, figs. 23-24, 1847.—DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 367, 1852.

Magasella flexuosa DALL, Amer. Journ. Conch., vol. 6, p. 135, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 189.

Magasella evansi DALL, Amer. Journ. Conch., vol. 6, p. 134, 1870, not of Davidson, 1852.

Terebratula rhombea PHILIPPI, Arch. f. Naturg., vol. 11, pt. 1, p. 59, 1845; (according to Davidson) Mon. Rec. Brach., pl. 17, figs. 6-8 *a*, 1887.

Magasella flexuosa DAVIDSON, *Challenger* Brach., p. 46, pl. 4, fig. 5, 1880; Mon. Rec. Brach., pt. 2, p. 92, pl. 17, figs. 1-5, 1887.

Type locality.—Port Famine, Magellan Strait. Captain King.

Cat. No.	Locality.	Collector.	Number of specimens.
11783	Orange Harbor, Patagonia	U. S. Exp. Ex	1
17822	Orange Harbor, Patagonia	U. S. Exp. Ex	1
96221	Magellan Strait, 61 fathoms	B. F.	6
332787	Magellan Strait	Fulton	1

I have expressed under the heading of the genus my opinion as to the distinctness of this species, which appears to me to have

[1] Proc. Acad. Nat. Sci. Phila. for 1891, p. 170.

reached its maturity retaining the *Magasella* characters. It is proper to say, however, that the series I have had for study has been small, and the subject is still open for further researches.

MAGASELLA VERCOI Blochmann.

Magasella vercoi BLOCHMANN, Trans. Roy. Soc. S. Austr., vol. 34, pp. 90, 93, pl. 27, figs. 1–5, 1910.

Megerlia willemoesi TATE, Trans. Roy. Soc. S. Austr., vol. 9, p. 110, 1886; not of Davidson.

Type locality.—Backstairs Passage, near Adelaide, South Australia, in 15 to 22 fathoms. Doctor Verco.

Cat. No.	Locality.	Collector.	Number of specimens.
214307	South Australia, 22 fathoms	Verco	3
111055	South Australia	Verco	2

Genus TEREBRATELLA Orbigny.

Terebratella ORBIGNY, Comptes Rendus Acad. Sci., vol. 25, p. 269, 1847; Pal. Franc. Ter. Crét., vol. 4, p. 110, 1847.

Type.—*Terebratula chilensis* Broderip.

TEREBRATELLA DORSATA Gmelin.

Anomia striata magellanica CHEMNITZ, Conch. Cab., vol. 8, p. 101, pl. 78, figs. 710, 711, 1785. (Non-binomial).

Anomia dorsata GMELIN, Syst. Nat., vol. 4, p. 3348, 1792.—BRUGUIÈRE, Encycl. Méth., pl. 242, figs. 4 *a–c*, 1798.

Anomia striata BOLTEN, Mus. Bolt., p. 192, No. 417, 1798.

Anomia dorsata DILLWYN, Descr. Cat. Rec. Sh., vol. 1, p. 295, 1817.

Terebratula dorsata LAMARCK, Anim. s. Vert., vol. 6, pt. 1, p.246, 1819.—ORBIGNY, Voy. Am. Mér. Moll., p. 675, 1846.—SOWERBY, Thes, Conch., vol. 1,p. 346, 68, figs. 15–17, 1847.—VON MARTENS, Mal. Blätt., 1872, pp. 9, 58.

Terebratula chilensis BRODERIP, Trans. Zool. Soc.,vol. 1, p. 141, pl. 22, figs. 1, 3–11, 1833.—OWEN, Trans. Zool. Soc., vol. 1, p. 145.

Terebratella chilensis ORBIGNY, Pal. Franc. Ter. Crét., vol. 4, p. 110, 1847.

Terebratula patagonica GOULD, Proc. Boston Soc. Nat. Hist., vol. 3, p. 347, 1850; U. S. Expl. Exp., Moll., p. 469, pl. 44, figs. 582 *a–c*, 1852; not of Sowerby, in Darwin, Geol. Obs., p. 253, 1846.

Terebratella dorsata H. and A. ADAMS, Gen. Rec. Moll., vol. 3, p. 576, pl. 130, figs. 4 4 *a.*, 1858.—CHENU, Man. de Conchyl., vol.2,p. 204, figs. 1043, 1045, 1862.—DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 184.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 75, pl. 14, figs. 9–19, 1887.

Terebratula (*Terebratella*) *magellanica* REEVE, Conch. Icon., *Terebratula*, pl. 5, figs. 21 *a–c*, 1860; Journ. de Conchyl., vol. 9, p. 127, 1861 (ex parte).

Waldheimia patagonica GOULD, Otia Conch., p. 246, 1862.

Magasella patagonica DALL, Proc. Acad. Nat. Sci. Phila. for 1873,p. 189.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 99, pl. 17, figs. 12–13 *a.*, 1887.

Type locality.—Magellan Straits.

Cat. No.	Locality.	Collector.	Number of specimens.
17815	Orange Harbor, Patagonia	U. S. Expl. Exp	1
332786	Magellan Straits	Fulton	5

TEREBRATELLA SOWERBII King.

Terebratula sowerbii KING, Zool. Journ., vol. 5, p. 338, 1831; (not of Owen, Trans. Zool. Soc., vol. 1, p. 49, pl. 22, figs. 15, 16, 1833).—SOWERBY, Thes. Conch., *Terebratula*, pl. 68, figs. 20, 22, 1847.

Terebratella dorsata DAVIDSON, (ex parte) *Challenger* Brach., p. 44, pl. 4, fig. 4, 1880; Mon. Rec. Brach., vol. 2, p. 77, pl. 14, fig. 12 ?, 1887.

Terebratella dorsata var. *submutica* FISCHER and OEHLERT, Mission Cap Horn. Brach., Bull. Soc. d'hist. Nat. d'Autun, vol. 5, p. 27, pl. 11, figs. 1–6, 1892.

Terebratella enzenspergeri BLOCHMANN, Zool. Anzeiger, vol. 30, p. 697, 1906.—EICHLER, Brach. Deutsche Sud Polar Exp., p. 392, pl. 42, figs. 10 *a–b*, 11 *a–d*, 12, 1911.

Type locality.—Magellan Straits. Captain King.

Cat. No.	Locality.	Collector.	Number of specimens.
110936	Magellan Straits, 20 fathoms	B. F	10
110937	Magellan Straits, 61 fathoms	B. F	20 yo.
106873	Magellan Straits, 61 fathoms	B. F	1 yo.

This seems to me distinct from the smooth variety of *Terebratella dorsata* with which it was associated by Davidson and Fischer. The species dissected and figured by Owen was undoubtedly the *dorsata*, judging by his figures, though referred to as *sowerbii* in his text.

TEREBRATELLA SANGUINEA Leach.

Terebratula sanguinea LEACH, Zool. Misc., vol. 1, p. 76, pl. 33, 1815.—CHENU, Bibl. Conchyl., Leach, p. 12, pl. 4, fig. 1, 1845.—DONOVAN, Nat. Rep., vol. 1, pl. 34, 1823.

Anomia sanguinea SOLANDER, MS. in Mus. Calonnianum, 1797.

? *Lampas sanguinea* (anonymous) Mus. Calonnianum, p. 45, No. 836, 1797 (nude name).

Anomia cruenta DILLWYN, Descr. Cat. Rec. Sh., vol. 1, p. 295, No. 25, 1817.

Terebratula zelandica DESHAYES, Rev. Zool. Soc. Cuvierienne, p. 359, 1839.—GUERIN, Mag. de Zool., Moll., pl. 42, 1841.—G. B. SOWERBY, Thes. Conch., vol. 1, p. 361, pl. 72, figs. 111 to 113, 1847.

Terebratula rubra SOWERBY, Thes. Conch., vol. 1, p. 345, p. 68, figs. 9–11, 1847; not of Pallas, 1766.

Terebratula zelandica DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 2, p. 367, 1852.

Terebratula evansi DAVIDSON, Proc. Zool Soc. for 1852, p. 77, pl. 14, figs. 7–9.—REEVE, Conch. Icon., *Terebratula*, pl. 8, fig. 31, 1861.

Terebratella cruenta GRAY, Cat. Brach, Brit. Mus., p. 89, 1853.—REEVE, Conch., Icon., *Terebratula*, pl. 5, fig. 20 *a–b*, 1860.—DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 183.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 87, pl. 14, figs. 1–8, 188-

Magasella evansi DALL (ex parte) Amer. Journ. Conch., vol. 6, p. 134, 1870.

? *Waltonia valenciennesi* DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 5. p. 475, pl. 15, figs. 1, *a–d*, 1850;

Type locality.—New Zealand.

Cat. No.	Locality.	Collector.	Number of specimens.
11896	Wellington, New Zealand	Colonial Mus	4
11896*a*	Bluff Harbor, New Zealand	Dr. Kershner	9

This fine species, except in color, is very close to *T. dorsata*. The *Magasella evansi* is now believed to be its *Magasella* stage. The *Waltonia* may also belong here, but representing a still earlier stage of development, common to several species, it can hardly be positively identified, though Mr. Davidson's last surmise allotted it to *T. rubicunda*.

TEREBRATELLA INCONSPICUA Sowerby.

Terebratula sanguinea QUOY and GAIMARD, Voy. *Astrolabe*, Zool., vol. 3, p. 556, pl. 85, figs. 6, 7, 1835; not of Leach, 1815.

Terebratula rubicunda SOWERBY, Proc. Zool. Soc., 1846, p. 92; Thes. Conch., *Terebratula*, p. 351, pl. 70, figs. 45–47, 1847; not of Donovan, Nat. Rep., pl. 56, figs. 2–4, 1823.

Terebratula inconspicua SOWERBY, Proc. Zool Soc., 1846, p. 93; Thes. Conch., *Terebratula*, p. 359, pl. 71, figs. 103–5, 1847.

Waltonia valenciennesi DAVIDSON, Ann. Mag. Nat. Hist., ser. 2, vol. 5, p. 475, pl. 15, fig. 1, 1850; according to Davidson, 1887.

Terebratella rubicunda DAVIDSON, Ann Mag. Nat. Hist., ser. 2, vol 9, p. 367, 1852.—REEVE, Conch. Icon., *Terebratula*, pl. 7, fig. 27, 1861.—DALL, Amer. Journ. Conch., vol. 6, p. 117, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 185.

Magasella inconspicua DALL, Amer. Journ. Conch., vol. 7, p. 67, 1871; Proc. Acad. Nat. Sci. Phila. for 1873, p. 189.

Terebratella rubicunda DAVIDSON, Mon. Rec. Brach., pt. 2, p. 84, pl. 15, figs. 15–29, 1887.

Type locality.—New Zealand.

Cat. No.	Locality.	Collector.	Number of specimens.
173490	New Zealand	Flower	2
77277	New Zealand	Stearns	1
98955	New Zealand	Dr. Kershner	15
17823	New Zealand	U. S. Expl. Exp	2v.
17824	New Zealand	U. S. Expl. Exp	7
11897	Sinclair Head, New Zealand	Colonial Mus	3
110969	Sinclair Head, New Zealand	Colonial Mus	8
11895	Wellington, New Zealand	Colonial Mus	10
110968	Stewart Island, New Zealand	C. Trail	5
253289	Auckland Harbor, New Zealand	J. Waite	4
76500	Cook Inlet, New Zealand	Stearns	1
77276	Camp Cove, New South Wales	Stearns	1

Quoy's name is preoccupied by Leach; Sowerby's *rubicunda* by Solander in Donovan, hence we must take Sowerby's second name given to the immature shell, afterwards described by me as a *Magasella*. Quoy's figure does not represent the attachment to the septum of the descending loop but the cardinalia are accurately figured and there can be no reasonable doubt that this is the species intended. The Australian locality is unexpected and may be inaccurate, but was probably due to one of Stearns' correspondents.

There is a feeble ridge in the pedicel valve hardly to be called a septum. There are no props to the hinge teeth. The foramen is normally entire but frequently open by reason of wear. The brachial valve has usually a prominent squarish cardinal process; a concave platform with a median ridge supported by a strong but low septum which extends to about the middle of the valve, which is retractively strongly uniplicate in some individuals, but not noticeably so in others, while still others have a number of additional minor plications.

TEREBRATELLA RUBIGINOSA Dall.

Terebratella sp. DALL, Amer. Journ. Conch., vol. 6, p. 122, pl. 6, fig. 4, 1870.

? *Terebratella suffusa* REEVE, Dall, Amer. Journ. Conch., vol. 7, p. 65, 1871 (not of Reeve).

Terebratella rubiginosa DALL, Amer. Journ. Conch., vol. 7, p. 65, 1871; Proc. Acad. Nat. Sci. Phila. for 1873, p. 135.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 91, pl. 16, fig. 19, 1887.

Type locality.—Simons Bay, Cape of Good Hope. W. Stimpson.

Cat. No.	Locality.	Collector.	Number of specimens.
5110	Cape of Good Hope	Stimpson	1

The species is entered in the early Smithsonian register with a large number of mollusks collected by Stimpson at the above locality during the Ringgold and Rodgers exploring expedition and I think there is no sufficient reason to doubt its having been part of that collection.

The pedicel valve has a short beak with a large incomplete foramen a hardly perceptible median ridge internally, no dental props, and there are four slender genital sinuses, the inner pair widely separated, simple, bifurcate at the extreme ends; the outer pair with five or six lateral branches on their outer sides.

The brachial valve is very slightly retractively uniplicate. It has a small rugose cardinal process, a concave platform, supported medially by a strong low septum reaching to the middle of the valve, a loop well represented by my figure of 1870; the genital sinuses are

widely separated, a single one on each side, arcuate, with five or six short, bifurcating, lateral, outer branches.

The species can not be united with any other which has come under my notice.

Genus BOUCHARDIA Davidson.

Bouchardia DAVIDSON, Bull. Soc. Géol. de France, sér. 2, vol. 7, pl. 1, figs. 1–6, 1849; Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 372, 1852.—DALL, Amer. Journ. Conch., vol. 6, p. 141, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 191.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 115, 1887.—J. ALLAN THOMSON, Trans. New Zealand Inst., vol. 47, pp. 392–403, 1915; Geol. Mag., dec. 6, vol. 5, No. 648, pp. 258–63, 1918.

Pachyrhynchus KING, Mon. Permian Fos., p. 70, 1852.

Type species.—*Anomia rosea* Mawe.

BOUCHARDIA ROSEA Mawe.

Anomia rosea MAWE, Linnean Syst. of Conch., p. 65, pl. 16, fig. 4, 1823.

Terebratula rosea SOWERBY, Gen. Shells, pt. 15, *Terebratula*, fig. 4, 1823; Tankerville Cat., p. 28, 1825.—ORBIGNY, Voy. Am. Mér., Moll., p. 675, 1846.—SOWERBY, Thes. Conch., *Terebratula*, p. 357, pl. 71, figs. 75–77, 1847.—HANLEY, Recent Biv. Shells, p. 322, 1856.

Terebratula tulipa BLAINVILLE, Dict. Sci. Nat., vol. 53, p. 144, 1828.

Terebratula unguis KÜSTER, Conch. Cab., ed. 2, *Terebratula*, p. 35, pl. 2*b*, figs. 8-10, 1848.

Bouchardia rosea DAVIDSON, Bull. Soc. Géol. de France, ser. 2, vol. 7, p. 62, pl. 1, figs. 1-6, 1849; Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 372, 1852.—DALL, Proc. Acad. Nat. Sci. Phila. for 1873, p. 191.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 115, pl. 20, figs. 13–18, 1887.

Pachyrhynchus roseus KING, Mon. Permian Fos., p. 70, 1852.

Terebratula (*Bouchardia*) *tulipa* REEVE, Conch. Icon., *Terebratula*, pl. 8, figs. 33 *a–c*, 1861.

Bouchardia tulipa GRAY, Cat. Brach. Brit. Mus., p. 100, 1853.—DALL, Amer. Journ. Conch., vol. 6, p. 141, 1870.

Type locality.—Rio Janeiro, Brazil.

Cat. No.	Locality.	Collector.	Number of specimens.
110951	Rio Janeiro	Acad. Nat. Sci	1
110952	Rio Janeiro, 59 fathoms	B. F.	Many v
96129	East of Rio Janeiro, 59 fathoms	B. F.	1 v.
212831	East of Rio Janeiro, 59 fathoms	B. F.	1 v.
110950	Montevideo	Ihering	1
332784	Brazil	Fulton	1

This interesting species appears to be rare, or at least not gregarious like most brachiopods.

Genus MAGADINA Allan Thomson.

Magadina J. ALLAN THOMSON, Trans. New Zealand Inst., vol. 47, p. 399, 1915

Type.—*M. browni* Thomson, fossil of the Mount Brown beds, Waipara District, New Zealand.

MAGADINA CUMINGII Davidson.

?*Terebratella cumingii* Davidson, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 368, 1852; Proc. Zool. Soc., 1852, p. 78, pl. 14, figs. 10–16.

Magas cumingii Gray, Cat. Brach. Brit. Mus., p. 99, 1853.—H. and A. Adams, Gen. Rec. Moll., vol. 2, p. 577, pl. 131, figs. 1, 1 *a.*, 1858.

Terebratula (*Bouchardia*) *cumingii* Reeve, Conch. Icon., *Terebratula*, pl. 8, fig. 29, 1861.

?*Terebratula* (*Bouchardia*) *fibula* Reeve, Conch. Icon., *Terebratula*, pl. 8, figs. 30 *a–b.*, 1861; Davidson, Mon. Rec. Brach., pt. 2, pl. 17, figs. 33, 33*a.*, 1887.

Magasella cumingii Dall, Amer. Journ. Conch., pt. 6, p. 137, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 188.—Davidson, *Challenger* Brach., p. 48, 1880; Mon. Rec. Brach., pt. 2, p. 97, pl. 17, figs. 23–32, 1887.

Magadina cumingii Allan Thomson, Trans. N. Zealand Inst., vol. 47, p. 400, fig. 12, 1915.

Type locality.—Port Jackson, New South Wales. For *M. fibula*, Bass Straits, New Zealand.

Cat. No.	Locality.	Collector.	Number of specimens.
206480	South Australia	Davidson	2
128938	Port Jackson, 4 fathoms	Brazier	3
128939	Port Jackson, 6 fathoms	Brazier	1
332785	South Australia	Fulton	4

Subfamily KRAUSSININAE.

Genus KRAUSSINA Davidson.

Kraussia Davidson, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 370, 1852.—Gray, Cat. Brach. Brit. Mus., p. 109, 1853.—H. and A. Adams, Gen. Rec. Moll., vol. 2, p. 578, 1858. Not *Kraussia* Dana, *Crustacea*, earlier in 1852.

Kraussina Davidson, in Suess. Wohnsitze der Brach., vol. 1, p. 28, 1859; Ann. Mag. Nat. Hist., ser. 3, vol. 8, p. 39, 1861.—Dall, Amer. Journ. Conch., vol. 6, p. 138, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 190.—Davidson, Mon. Rec. Brach., pt. 2, p. 118, 1887.

Kraussinia Paetel, Fam. and Gen. of Moll., p. 104, 1875.

Type.—*Anomia rubra* Pallas.

KRAUSSINA RUBRA Pallas.

Anomia rubra Pallas, Miscel. Zool., p. 182, pl. 14, figs. 2–11, 1766.

Anomia capensis Gmelin, Syst. Nat., p. 3347, 1792.

Terebratula rubicunda Donovan, Nat. Repository, vol. 2, pl. 56, figs. 2–4, 1823 (as of Solander MS.; not *T. rubicunda* Sowerby).

Terebratula rubra Blainville, Dict. Sci. Nat., vol. 53, p. 138, 1828.—Sowerby, Thes. Conch., *Terebratula*, p. 345, pl. 68, fig. 10, 1847.—Reeve, Conch. Icon., *Terebratula*, pl. 9, fig. 37 *a–c.*, 1861.

Terebratula capensis Küster, Conch. Cab., ed. 2, *Terebratula*, p. 32, pl. 3, figs. 15–17, 1848.—Krauss, Sud Afrikan. Moll., p. 32, pl. 2, fig. 10, 1848; not of Adams and Reeve, Voy. Samarang, 1850.

Kraussia rubra Davidson, Ann. Mag. Nat. Hist., ser. 2, vol. 9, p. 370, 1852.—Gray, Cat. Brach. Brit. Mus., p. 109, fig. 19, 1853.

Kraussina rubra SUESS, Wohns. der Brach., p. 210, 1859.—DAVIDSON, Ann. Mag. Nat. Hist., ser. 3, vol. 8, p. 39, 1863.—DALL, Amer. Journ. Conch., vol. 6, p. 138, fig. 17, 1870; Proc. Acad. Nat. Sci. Phila. for 1873, p. 190.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 119, pl. 20, figs. 19–23, 1887.
Terebratula rotundata BLAINVILLE, according to Reeve.

Type locality.—Cape of Good Hope, South Africa.

Cat. No.	Locality.	Collector.	Number of specimens.
17817	Cape of Good Hope	Stimpson	2
32925	Cape of Good Hope	U. S. Expl. Exp.	2
110958	Cape of Good Hope	Dall	1
98043	Peddie, South Africa	Albany Mus	4

KRAUSSINA GARDINERI Dall.

Kraussina gardineri DALL, Brach. of the *Sea Lark* Exped., Trans. Linn. Soc. London, ser. 2, Zool., vol. 13, p. 440, pl. 26, figs. 3–6, 1910.

Type locality.—Indian Ocean, south of the Saya de Malha Banks in 123 to 153 fathoms, station C 1. J. Stanley Gardiner.

Cat. No.	Locality.	Collector.	Number of specimens.
111085	Indian Ocean	Sea Lark Exp.	1

KRAUSSINA NATALENSIS Krauss.

? *Terebratula pisum* LAMARCK, Anim. s. Vert., vol. 6, p. 245, 1819.—DESHAYES, in Lamarck, Anim. s. Vert., ed. 2, vol. 7, p. 330, 1836, not of Sowerby, 1829.
Terebratula natalensis KRAUSS, Sud Afrikan. Moll., p. 33, pl. 2, fig. 11, 1848.—KÜSTER, Conch. Cab., ed. 2, vol. 7, p. 36, pl. 2*b*, figs. 4–7, 1848.
? *Terebratula algoënsis* SOWERBY, Proc. Zool. Soc., 1846, p. 95; Thes. Conchyl. *Terebratula*, p. 362, pl. 71, figs. 91, 92, 1847.
Kraussia pisum H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 579, pl. 131, figs. *a–b.*, 1858.—REEVE, Conch. Icon., *Terebratula*, pl. 9, fig. 36 *a–b*, 1861.
Kraussina pisum SUESS, Wohnsitz. der Brach., p. 211, 1859.—DALL, Amer. Journ. Conch., vol. 6, p. 140, 1870.—DAVIDSON, *Challenger* Brach., p. 54, pl. 4, figs. 7, 8, 1880; Mon. Rec. Brach., pt. 2, p. 123, pl. 21, figs. 1–4, 1887.

Type locality.—Natal Point, South Africa. Krauss.

Cat. No.	Locality.	Collector.	Number of specimens.
64336	South Africa	Krauss	1

The *T. pisum* of Lamarck, according to his text, written by Valenciennes on account of Lamarck's blindness, came from Mauritius,

where it was collected by M. Mathieu. It was a smooth subglobular red shell resembling a cherry stone and 9 millimeters broad. These characters do not suggest Krauss's shell. The *algoënsis* of Sowerby was founded on an ovate worn and defective pedicel valve, quite unrecognizable from the figure, and not resembling the transverse *K. natalensis*.

Genus MEGERLINA Deslongchamps.

Megerlina DESLONGCHAMPS, Etudes crit. sur les Brach., p. 159, pl. 19, fig. 11, 1884.—DAVIDSON, Mon. Rec. Brach., pt. 2, p. 124, 1887.

Type.—*Kraussia lamarckiana* Davidson.

MEGERLINA LAMARCKIANA Davidson.

Kraussia lamarckiana DAVIDSON, Proc. Zool. Soc., 1852, p. 80, pl. 14, figs. 22, 23.—GRAY, Cat. Brach. Mus., p. 111, 1853.—WOODWARD, Man. Moll., p. 218, fig. 120, 1858.

Trerbratula (*Kraussia*) *lamarckiana* REEVE, Conch. Icon., *Terebratula*, pl. 9, fig. 34, 1861.

Kraussina lamarckiana SUESS, Wohnsitz der Brach., p. 211, 1859.—DALL, Amer. Journ. Conch., vol. 6, p. 139, fig. 18, 1870.—DAVIDSON, *Challenger* Brach., p. 53, pl. 4, figs. 9 *a–b*, 1880.

Megerlina lamarckiana DESLONGCHAMPS, Etudes crit. sur les Brach., p. 159, pl. 19, fig. 11, 1884.

Kraussina (*Megerlina*) *lamarckiana* DAVIDSON, Mon. Rec. Brach., pt. 2, p. 124, pl. 21, figs. 7–11, 1887.

Type locality.—Sydney, New South Wales, Australia.

Cat. No.	Locality.	Collector.	Number of specimens.
11893	Australia	Damon	4
101389	Australia	Stearns	7
75177	Australia	Walpole	4
160381	South Australia	Reed	1
110959	Sydney, New South Wales	Dall	8
173590	Sydney, New South Wales	Jeffreys	1

This small species is said to exist in large numbers at Port Jackson, in a few feet of water, uncovered at lowest tides. It is reported by Tenison Woods as abundant at Tammi Heads, New Zealand, but no specimens from New Zealand have come under my observation.

NOTE.—I owe to the kindness of Mr. C. Davies Sherborn, of the British Museum, the following dates of issue of Küster's Brachiopoda of the second edition of Chemnitz Conchylien Cabinet, which are not dated in the original:

Text, pages:	Date.	Part.
1–8	1843?	...
9–24	1843	41
25–40	1848	75
41–84	1868	186

Plates:

1, *2b*, 13	1844	45
5, 8, 12	1843	41
2c, *2d*, 14	1848	75
2, 3, 4, 9, 10, 11	1843	40
6, *6b*	1858	161
7	1845	56

REFERENCES TO GROUPS CITED.

HOLARCTIC TRIBES OF THE ICHNEUMON-FLIES OF THE SUBFAMILY ICHNEUMONINAE (PIMPLINAE).

By R. A. Cushman and S. A. Rohwer,

Of the Bureau of Entomology, United States Department of Agriculture.

INTRODUCTION.

This paper, which is a joint contribution of the Branch of Deciduous Fruit Insect Investigations and the Branch of Forest Insects of the Bureau of Entomology, is the result of study extending over a period of several years, and embodies the opinion of the authors as to the relationship and number of tribes of the Ichneumoninae (Pimplinae Authors) as represented in the Holarctic region. As originally planned, we had hoped to prepare a joint paper on the entire group, but since, because of interruptions by other work, such a paper is found impracticable we have considered it advisable to present a tribal synopsis as a basis for subsequent revision of the minor groups.

The change of the subfamily name is necessary because the type of the genus *Ichneumon* is *Ichneumon manifestator* Linnaeus [1] and has as synonyms the isogenotypic genera *Pimpla* Fabricius and *Ephialtes* Gravenhorst (not Schrank).[2] The subfamily name Pimplinae must therefore be suppressed in favor of Ichneumoninae and the subfamily Ichneumoninae of authors will be Joppinae after the name of the oldest included genus.

HISTORICAL.

The beginning of the classification of the Ichneumoninae dates of course from Linnaeus, but since the writers preceding Gravenhorst

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[1] Morice and Durrant, (Trans. Ent. Soc. Lond., 1914, p. 388) contend that the type of the genus *Ichneumon* is *Ichneumon persuasorius* Linnaeus, a species given by Lamarck (1801) as an example for the genus *Ichneumon*. We can not agree with them in this nor do we believe that the rulings in the Code of International Zoological Nomenclature will uphold the acceptance of the Lamarckian examples as type designation. The code specifically says "The meaning of the expression 'select a type' is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type." Lamarck and most of the older writers, including most of Latreille's works, gave examples only as an illustration of the genus and not as a type designation.

[2] See Cushman and Rohwer, Proc. Ent. Soc. Wash., vol. 20, 1919, p. 186.

had done little more than describe genera and species they contributed only slightly to the taxonomy of the group and it is not necessary to discuss their work in detail.

From the beginning the classification of the Ichneumoninae has been rendered unsatisfactory and difficult by the exclusive employment of characters of such nature that they apply to but one sex, or are conspicuous only in more or less extreme types, while absent or inconspicuous in other genera obviously closely allied. In addition all recent classifications have followed very closely that of Foerster which was based almost entirely on Holarctic genera, and the attempt to adapt this arrangement to the genera of the world has added much to the confusion.

Gravenhorst.—In 1829 Gravenhorst[1] published the first real attempt at the classification of the Ichneumonidae. He divided the family into thirteen genera. Most of these he subdivided into a number of families or subgenera to which he gave names, and some few of these he further divided into unnamed groups which he called sections. All of Gravenhorst's subgenera and many of his sections have since been raised to generic rank.

Of the genera treated by Gravenhorst as subgenera that are here placed in the subfamily Ichneumoninae, seven, *Glypta*, *Lissonota*, *Polysphincta*, *Clistopyga*, *Pimpla*, *Ephialtes*, and *Rhyssa*, he considered as subgenera of *Pimpla*. As subgenera of *Pimpla* Gravenhorst also included *Schizopyga* and (*Trachyderma*) = *Tylocomnus*, both now placed in the subfamily Tryphoninae. *Xorides*, *Xylonomus*, *Odontomerus*, and the Cryptine genus *Echthrus* constituted his genus *Xorides*. *Coleocentrus* and *Arotes* were the unnamed subgenera IV and VI respectively of his genus *Banchus*. *Phytodietus* he placed as subgenus VIII of *Cryptus*. *Acoenites* formed a genus by itself without subdivisions.

Gravenhorst's key is in the form of a chart classifying the insects down to subgenera, which are bracketed into their genera. The characters employed are mostly superficial, indefinite, or unisexual and have largely persisted up to the present for the major divisions within the group.

Holmgren.—Holmgren[2] separated the Ichneumonidae into five families corresponding to the usual five subfamilies. He made no key to these families, but gave a rather long description of each, mentioning nearly all parts.

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[1] J. L. C. Gravenhorst, Ichneumonologia Europaea, Vratislaviae, Sumtibus Auctoris, 1829, vol. 1, pp. i–xxxiii, 1–827; vol. 2, pp. 1–989; vol. 3, pp. 1–1097.

[2] A. E. Holmgren, Försök till Uppställning och Beskrifning af de i Sverige Funne Tryphonider, Kongliga Svenska Vetenskaps-Akademiens Handlingar, 1855, pp. 93–394, 2 pls.

In 1859 [1] he published his first synopsis of his family Pimplariae. This he divided into two main sections which he called Pimplariae and Xorides, the latter corresponding to the tribe Xoridini of Ashmead, and the former including genera since divided into the tribes Acoenitini, Lissonotini, and Pimplini. His main divisions are based on practically the same characters as those used by Gravenhorst, while those of the smaller divisions were new and still largely persist in the more recent keys. The generic descriptions are full and detailed, and the Swedish species are listed under each genus. In the following year he published a larger work [2] in which the generic key is largely reprinted from the earlier paper, but each Swedish species is discussed in considerable detail. His two main sections are here called subfamilies.

Cresson.—The first American writer to take more than a general interest in the Hymenoptera was Cresson, who in 1887 published his Synopsis.[3] For this work Cresson claims little originality, confessing to having compiled his keys from the writings of previous authors. He did, however, a valuable work in marshaling the known North American species and added much to the knowledge of the group in America.

Cresson's key to the Pimplinae is much easier to use than most others. He, however, made no attempt to divide the subfamily into tribes nor to express by his key the relationship of the genera to each other. His specific keys, based largely on color, are useful, although too much reliance must not be placed on characters of this sort.

Foerster.—A few years after Holmgren had published his synopsis Foerster [4] produced his system of classification of the Ichneumonidae. In this work he divided the group into 34 coordinate families, 4 of which, the Pimploidae, Lissonotoidae, Acoenitoidae and Xoridoidae, together with Ashmead's tribe Labenini, constitute the five tribes into which Ashmead divided the subfamily Pimplinae. The Xoridoidae represent Holmgren's section II; the Acoenitoidae, section I, division 1; the Pimploidae, section I, division 2, phalanges 1 and 2; and the Lissonitoidae, section I, division 2, phalanx 3.

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[1] A. E. Holmgren, Conspectus Generum Pimplariarum Suecia, Öfversigt af Konigliga Svenska Vetenskaps-Akademiens Förhandlingar, vol. 6, 1859, pp. 121–132.

[2] A. E. Holmgren, Försök till Uppställning och Beskrifning af Sveriges Ichneumonider, Monographia Pimplariarum Sueciae, Konigliga Svenska Vetenskaps-Akademiens Handlingar, vol. 3, No. 10, 1860, pp. 1–76.

[3] E. T. Cresson, Synopsis of the Families and Genera of the Hymenoptera of America North of Mexico, 1887, supplementary volume of Trans. Amer. Ent. Soc., pp. i–vi, 1–350.

[4] Arnold Foerster, Synopsis der Familien und Gattungen der Ichneumonen, Verh. nat. hist. Ver. preuss. Rheinl., vol. 25, 1868, pp. 142, 162–170.

For his larger divisions Foerster used many of the old Gravenhorstian characters supported by those of Holmgren, but added many new ones to define his much finer subdivisions. He tabulated and named many new genera, most of them without further diagnosis and without including any species or designating types. This, together with the extremely minute differences which Foerster considered of generic value, makes the determination of his genera very difficult. Indeed, many of them stand to-day without included species. The difficulties in this respect are perhaps less in the Ichneumoninae than in almost any other group, although even there one must exercise considerable liberality in the interpretation of characters to satisfactorily place a species in its genus.

Practically all authors since Foerster have followed him very closely. Especially is this true of Ashmead and Schmiedeknecht whose keys are largely translations or adaptations of Foerster, with new genera and new characters interpolated occasionally.

Foerster's work, left unfinished as it was, has thrown much light on the classification of the Ichneumonoidea, but because of his unsupported use of unisexual and variable characters it has also added much to the confusion of this difficult group.

Thompson.—In his treatment of the Ichneumoninae in his Opuscula Entomologica Thomson[1] followed largely the System of Holmgren. He published no tribal nor generic tables, but his keys to species abound in new and useful characters. It is indeed unfortunate that Thomson did not apply his clear insight to an attempt to clarify the classification of the Ichneumonidae as a whole. No other worker has appreciated as did he the extent of variation in the group or the little dependence that can be placed in the superficial characters used for the separation of the larger groups.

His contributions concerning the Ichneumoninae are scattered through several fascicles of his Opuscula Entomologica and consist largely of keys to Swedish species and observations on those species.

Davis.—In presenting his review of North America Tryphoninae Davis[2] gives, without grouping them into subfamilies, a synopsis of the tribes of the Ichneumonidae. This synopsis follows very closely (so closely in fact that up to couplet 10 it is a translation) Foerster's key of the natural families of Ichneumonidae, and has its use mainly in being its author's interpretation of Foerster and in giving a definition of the tribes he treats.

[1] C. G. Thomson, Opuscula Entomologica, Lund, fascicles 5, 8, 9, 12, 13, 19, and 21, 1873–1896.

[2] G. C. Davis, A Review of the Ichneumonid subfamily Tryphoninae, 1897, Trans. Amer. Ent. Soc., vol. 24, pp. 193–348.

Ashmead.—Ashmead[1] in his treatment of the Ichneumoninae groups together, and considers as tribes, Foerster's families Acoenitoidae, Lissonotoidae, Pimploidae, and Xoridoidae and adds the tribe Labinini, a group not represented in Europe. In his method of treatment and in his choice of characters Ashmead follows very closely the work of Foerster, and in the main his paper is a translation of Foerster with the addition of new and a subsequently described genera. Many of the characters are taken only from the female, which makes it impossible to satisfactorily place males, and the venation is used extensively. The shape and presence or absence of the areolet is used repeatedly as a primary character and much value is attached to the angulation of the discocubitus, the presence or absence of a ramulus, the position of the nervulus, and the point of fracture of the nervellus. In fact the entire classification is founded on an insufficient and superficial study of a few types. The characters offered will not apply to all of the species which were placed in the various genera as arranged in Ashmead's collection or that of the United States National Museum as it was arranged by him. Unsatisfactory as his classification is, it has been useful because it brought together and gave some characters for the numerous genera described up to 1900. It must be remembered, however, that Ashmead endeavored to include all the described genera, and in a number of cases was forced to use only the descriptions which are frequently insufficient and offer only characters that are often of questionable value.

Schmiedeknecht.—The treatment of the subfamily Ichneumoninae as given by Schmiedeknecht[2] in the Genera Insectorum adds but little information which will aid in the satisfactory classification of these insects. The work is founded, in great part, on that of Foerster and Ashmead, and is a conservative adaptation of their work with the recently described genera included. There are, however, some transfers of genera and in some places certain groups which Ashmead treated as genera are treated as subgenera, yet many of the mistakes made by Ashmead are copied and the same kind of characters are used. It is, however, a useful work and if it shows but little originality we can perhaps excuse the author because of the difficulty of the group, the area covered, and the lack of representatives of many of the genera.

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[1] W. H. Ashmead, Classification of the Ichneumon Flies, or the Superfamily Ichneumonoidea, Proc. U. S. Nat. Mus., vol. 23, 1900, pp. 1-220.

[2] Otto Schmiedeknecht, Subfamily Pimplilnae, Gen. Ins., fasc. 62., 1907, pp. 1-120, pls. 1-2.

Morley.—Claude Morley in his recent papers[1] dealing with the insects grouped together as the subfamily Ichneumoninae has offered a number of new suggestions in arrangement and expressed a doubt that all the members are closely related, as the following quotation (1*a*, p. xv) will show: "That the Lissonotides have any close relationship with the typical Pimplides I do not for a moment believe; the Acoenitides, as at present grouped, are very heterogeneous; and the Banchides are admittedly aberrant, wherever placed; while the Xoridides, though related to some extent in their thoracic structure with Rhyssa, appear worthy of ranking as a distinct subfamily."

In 1908 (1*a*) Morley adds the tribe Banchides to his subfamily Pimplinae and in 1913 (1*b*) he raises the genus *Rhyssa* and allies to tribal rank (in 1908 he still had this group in the Pimplini) and makes a tribe, Ecthromorphides, for the genera *Lissopimpla* and *Ecthromorpha*. This last tribe is an arbitrary grouping on two variable venational characters and the lengthening of the malar space, the latter so variable as to be of doubtful generic value.

In his definition of the subfamily Pimplinae (1*a*, p. XVI) he makes use of a secondary sexual character and adds in a qualifying way an extremely variable specific character. The key to the tribes (1*a*, p. 1) makes use of some of the usual characters and one is at a loss to know how the Theronini can be placed in the Pimplides as he defines them. It would seem that Morley has done but little more than offer a rearrangement of names, for when he has given additional characters they are usually of such nature as to be subject to individual variation or are unisexual and should not be used, unsupported, as prime characters of genera or higher groups.

It must not, however, be implied that we would belittle the work of Morley, because with all its shortcomings it is very useful and clears up many obscure points about the species which are represented in the British Museum by type material, and gives useful keys to distinguish the material in that museum.

Viereck.—In the recent synopsis of the genera of Ichneumon flies of Connecticut, Viereck,[2] does away with subfamily divi-

[1] (*a*) Claude Morley, Ichneumonologia Britannica III. The Ichneumons of Great Britain, etc., Pimplinae, 1908, H. and W. Brown, London, England, pp. i-xvi, 1-328.

(*b*) Claude Morley, A revision of the Ichneumonidae Based on the collection of the British Museum, part 2, Tribes Rhyssides and Echthromorphides, 1913, London, pp. i-vi, 1-48.

(*c*) Claude Morley, Idem., part 3, tribe Pimplides, 1914, pp. i-viii, 1-122.

(*d*) Claude Morley, Idem., part 4, tribe Banchides, 1915, pp. ix-x, 135-151.

[2] H. L. Viereck, The Hymenoptera, or Wasp-like Insects, of Connecticut, 1917, Bull. 22, Geol. and Nat. Hist. Survey Conn., pp. 243-326.

sions,[1] and, after removing the closely allied genus *Banchus* on a character subject to specific variation, he separates the genera belonging to the Ichneumoninae as here defined from the other genera of the Ichneumonidae in much the same unsatisfactory manner as that of Ashmead, and in many places only on secondary sexual characters. There are, however, a few new characters, and the work has contributed something to render the Ichneumoninae of the limited region somewhat better understood.

CLASSIFICATION.

In presenting this revision of the subfamily Ichneumoninae we do not wish to be construed as expressing an opinion that it is a natural group. The family Ichneumonidae is a group composed of elements showing remarkable differences but at the same time extreme homogeneity. So true is the latter that the grouping into five universally recognized subfamilies is, in our opinion, untenable. The published keys for the separation of these five subfamilies leave the placing of a species in its proper subfamily almost entirely to the imagination or experience of the worker. On the other hand, the strict interpretation of such characters as these keys offer frequently leads even the experienced taxonomist to entirely misplace an insect; and disagreement among workers as to the allegiance of certain genera or groups of genera is very frequent. The Plectiscini, Banchini, and Paniscini are notable as bones of contention, while all of the subfamilies, notably the Tryphoninae and Ophioninae, are aggregations of groups not at all closely allied but thrown together on such superficial characters as compression or depression of abdomen, long or short ovipositor, possession or lack of sternauli, shape, presence or absence of the areolet, etc. Anyone who has studied the insects of this group in an at[...]l intensive manner knows that such characters as these [...]eless as used in the keys, and he also knows that in de[...]ng species he places them in the subfamilies without regard [...] characters of the keys but entirely from his knowledge of [...]

[...]ubfamily Ichneumoninae, as treated here, is practically the [...] the subfamily Pimplinae in the sense of Holmgren, Cresson, [...]mead, and others, with a genus here and there rejected as not [...]rable to the subfamily. We have adopted this restriction of the [...]family as a matter of convenience and in accordance with the

[1] Since the above was written Viereck has (Proc. Biol. Soc. Wash., vol. 31, 1918, p. 69) elevated all of the [...]bes of the Ichneumonoidea to subfamily rank for the very naive reason, "to avoid confusion in referring [...] groups of genera by word of mouth." In Ent. News, vol. 31, 1920, p. 16, he makes a family for the genera [...]abena Cresson, *Apechoneura* Kreichbaumer, and *Psiloparia*, new genus. The value of this grouping has [...]een discussed by Cushman, Proc. Ent. Soc. Wash., vol. 22, no. 4, 1920.

project as originally conceived, which was to revise the North American Pimplinae.

It seems very probable that the Ichneumoninae as here treated is composed of a number of phylogenetic branches, associated by more or less similarity of habitus and superficial structure, and forming a group which, because of its discordant elements, is so closely related to groups in other subfamilies as to make definition of it as a unit extremely difficult if not impossible. The same is true, to greater or less extent, of the other four subfamilies. Because of this, it does not seem advisable to offer any other definition of the limits of the subfamily Ichneumoninae than to say that this tribal synopsis is based on the Pimplinae as limited by Ashmead and the genera described since 1900. The student unfamiliar with these insects will therefore necessarily have to refer to the unsatisfactory definitions offered by Ashmead, Cresson, and others.

In spite of the probable diversity of origin of the tribes, constant diagnostic characters are very rare, and our keys to the tribes include the most available characters. Not all of these characters taken singly are of tribal value; in fact such characters are very rare in the Ichneumonidae. It is rather an assemblage of characters, which taken together form the peculiar structure and habitus that distinguish the members of one tribe from those of another.

The remarks in regard to the subfamilies set forth above are equally applicable to the usual five tribes of the Ichneumoninae. None of the existing keys to these tribes is usable by the beginner in the taxonomic study of these insects unless he has access to an extensive named collection for comparison. This is due partly to the attempt of the authors of the keys to place all the genera in the five tribes originally proposed by Ashmead; partly to the use of extreme or unisexual characters unsupported by characters applying to the other sex, or of those variable within a genus, or there repre-
statement of characters that do not apply to all species platful keys
given tribe; and partly to a too superficial study of the speci
when careful study has been made, a laissez-faire policy Ichneu-
attempting a revision of the keys. In other words, in orderily divi-
a given species to its genus one must be able from the kn etc., Pim-
gained only by long experience to tell at once the tribe to which
species should be referred. The tribal keys, being unusable by part
beginner and unnecessary to the experienced, are useless, or wo
(so far as the beginner is concerned), misleading.

We are convinced that the entire biology and the characters displayed by all stages are of importance as indicating relationship or divergence and that whatever of this sort of information is available should be taken advantage of as a guide to classification. In pro-

posing the following arrangement of tribes we have therefore taken into consideration what we know of larval structure, nature of the host, and relation of parasite to host. We have found that the structure of the ovipositor and of the terminal segments in the female have been developed similarly in genera which have similar larval structures and host relations. These characters in the female are of such nature that they can be easily seen and expressed briefly and positively. We have therefore considered it advisable to present a key based entirely on the female, making use of sexual and secondary sexual characters. We recommend the use of this key to beginners and others unfamiliar with the group and believe that less difficulty will be experienced in its use than in the use of the key in which the secondary sexual characters are eliminated. This last mentioned key, while not entirely satisfactory, serves to distinguish the tribes which we believe to be represented among the genera studied and sets forth the best characters applicable to both sexes.

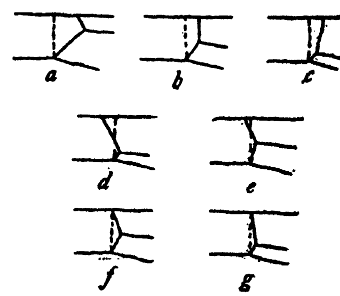


FIG. 1.—NERVELLI: *a*, *b* AND *c*, RECLIVOUS; *d* AND *e*, INCLIVOUS; *f* AND *g*, PERPENDICULAR.

There are three new terms which are used in this paper, and the authors expect to make use of these terms in future works. They may be defined as follows:

A perpendicular nervellus (fig. 1, *f*, *g*) is one in which the anterior end is opposite the posterior end, that is, one in which a line drawn touching both the anterior and posterior ends is at right angles to the longitudinal axis of the submediallan cell. Other authors have called this a continuous or interstitial nervellus.

An inclivous nervellus (fig. 1, *d*, *e*) is one in which the anterior end is nearer the base of the wing than is the posterior end. This has heretofore been spoken of as an antefurcal nervellus.

A reclivous nervellus (fig. 1, *a*, *b*, *c*) is one in which the posterior end is nearer the base of the wing than is the anterior end. This has heretofore been spoken of as a postfurcal nervellus.

We have substituted the terms inclivous and reclivous for the ambiguous and unsatisfactory terms antefurcal and postfurcal; and have adopted the less used term perpendicular because we believe that it is less confusing and more in keeping with the terms inclivous and reclivous. The terms interstitial, antefurcal, and postfurcal are used in the usual sense for such veins as the nervulus and recurrents and in this sense are easily understood and in keeping with the exact meaning of the words.

KEY TO TRIBES BASED ON FEMALES.

1. Ovipositor with a dorsal notch a short distance back from apex; (internal parasites of Lepidopterous larvae), fig. 2 .... 2.

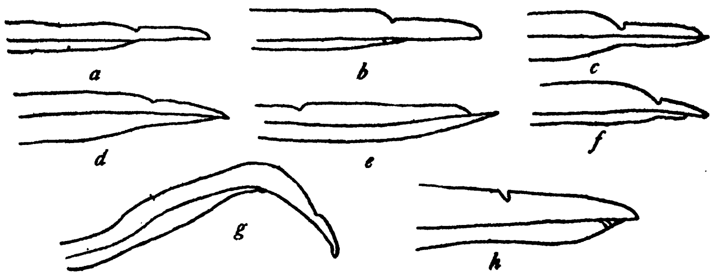


FIG. 2.—APICES OF OVIPOSITORS: *a*, GLYPTA SIMPLICIPES CRESSON; *b*, LAMPRONOTA AMERICANA CRESSON; *c*, ARENETRA NIGRITA WALSH; *d*, MENISCUS SCUTELLARIS CRESSON; *e*, CYLLOCERIA LUGUBRIS CRESSON; *f*, LAMPRONOTA FRIGIDA CRESSON; *g*, LISSONOTA VERBERANS GRAVENHORST; *h*, AMERSIBIA PRIONOXYSTI ROHWER.

Ovipositor without such a notch ....

2. Tergites without oblique furrows .... *Lissonotini.*
Tergites with oblique furrows extending from basal middle to near apical margin .... *Glyptini.*

3. Tarsal claws pectinate; apex of ovipositor spear-head like; (parasites of Lepidopterous larvae), fig. 3 .... 4.

FIG. 3.—APICES OF OVIPOSITORS: *a*, TOXOPHOROIDES ALBOMARGINATA (CRESSON); *b*, PHYTODIETUS BURGESSI CRESSON. HIND TARSAL CLAW: *c*, PHYTODIETUS BURGESSI CRESSON.

Tarsal claws simple or with a large basal tooth or lobe, fig. 4 .... 5.

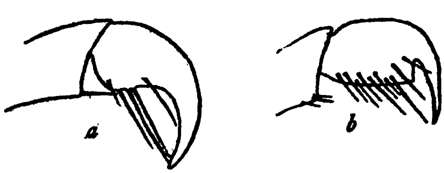


FIG. 4.—HIND TARSAL CLAWS: *a*, ITOPLECTIS CONQUISITOR (SAY); *b*, ICHNEUMON IRRITATOR FABRICIUS.

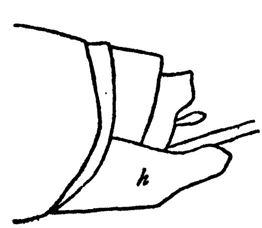


FIG. 5.—APEX OF FEMALE ABDOMEN OF TOXOPHOROIDES ALBOMARGINATA (CRESSON) (*h*=HYPOPYGIDIUM.)

4. Tergites 1–4 with oblique and apical transverse furrows and strongly sculptured; scutellum margined laterally; hypopygidium heavily chitinized and extending to or beyond apex of abdomen, fig. 5 .... *Lycorini.*
Tergites without furrows and polished; scutellum not margined; hypopygidium neither especially heavily chitinized nor prominent .... *Phytodietini.*

5. Ovipositor short, never more than half as long as abdomen, compressed, with a distinct swelling below at or about the middle, beyond which it tapers to a very acute point; clypeus strongly convex, rounded at or most truncate at apex, never medially impressed or inflexed; last tarsal joints swollen, claws and onychii very large, all claws with basal tooth; face narrow, convergent below; mandibles narrow at apex, upper tooth much the longer; areolet only rarely defined; (external parasites on spiders), fig. 6 .... *Polysphinctini*.

FIG. 6.—APICES OF OVIPOSITORS: *a*, POLYSPHINCTA TEXANA CRESSON; *b*, HYMENOEPIMECIS WILTII (CRESSON); MANDIBLE: *c*, HYMENOEPIMECIS WILTII (CRESSON).

Ovipositor either short or long, but never formed as above; clypeus most frequently impressed and emarginate medially, occasionally inflexed and truncate or rounded at apex; apical tarsal joints rarely swollen or with large claws and onychia; mandibles either broad and bidentate at apex with equal teeth or acute and edentate, in the latter case rarely with a small inner tooth.... 6.

6. Ovipositor never nearly as long as body, cylindrical, or nearly, occasionally depressed or decurved at apex; claws simple, without a basal lobe or tooth, occasionally (*Itoplectis*) with claws of front tarsi lobed or (*Apechthis*) all or front and middle claws lobed, in the last genus the ovipositor is decurved at apex; notauli either absent to obsolete or very deep and pit-like anteriorly, where they are set off by sharp carina that runs back along the margin of the lateral lobe; areolet always present; nervellus always strongly reclivous with the discoidella at or near the upper end; clypeus broadly truncate or arcuate at apex, rarely with a distinct median notch-like emargination.............................. 7.

Ovipostor compressed, or if cylindrical it is very long and slender or upcurved; all claws either with or without basal lobes or teeth; notauli strong, rarely weak, or entirely wanting, but never defined as above.......................... 8.

7. Dorsal margin of lance straight to apex; propodeal spiracle slit-like, the surrounding carina prominent, separated from anterior margin of propodeum by less than its length; notauli subparallel, terminating abruptly posteriorly; polished, with abdomen impunctate; species usually largely bright ferruginous or yellowish; (secondary parasites), fig. 7... *Theroniini*.

FIG. 7.—APEX OF OVIPOSITOR OF THERONIA FULVESCENS CRESSON.

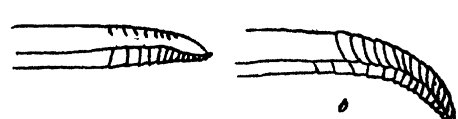


FIG. 8.—APICES OF OVIPOSITORS: *a*, ITOLPLECTIS CONQUISITOR (SAY); *b*, APECHTHIS PICTICORNIS (CRESSON).

either decurved near apex or it is flattened at apex; propodeal
nd to long oval, rarely slit-like, and usually separated
propodeum by at least its length; notauli when st perpendicular,
at posteriorly; species usually black or blackish...... *Glyptini*.
ctured, seldom both pale and with abdomen
parasites of Lepidopterous pupae), fig. 8.. South American genus
ne of the other characters

Hypogidium very large, vomeriform, acute at apex, very heavily chitinized; clypeus broadly truncate at apex, frequently sharply inflexed and with a more or less distinct median tooth; labrum exserted, (parasites on wood-boring larvae), fig. 9..*Acoenitini*.

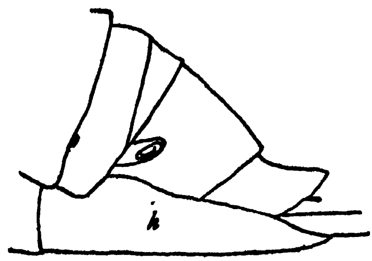


FIG. 9.—APEX OF ABDOMEN OF FEMALE OF COLEOCENTRUS OCCIDENTALIS CRESSON.

Hypopygidium not as above, usually retracted far from apex of abdomen, very rarely (*Clistopyga*) reaching apex.................................... 9.

9. Occipital carina obsolete or interrupted dorsally; mesoscutum and scutellum transversely rugose throughout; apical tergite greatly lengthened; (external parasites on wood-boring larvae).................................*Rhyssini*.

Occipital carina complete; mesoscutum and scutellum not transversely rugose, at most the scutum is rugulose; apical tergite only rarely greatly lengthened. 10.

10. Abdomen inserted above, frequently far above, the hind coxae; first tergite narrow throughout; head transverse; occiput narrow, barely concave; temples short and strongly convexly sloping; eyes emarginate within; propodeum nearly straight and horizontal from base to insertion of abdomen; hind coxae. long, slender and nearly uniform in diameter, fig. 10................*Labenini*.

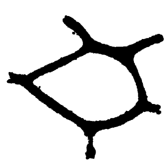


FIG. 10.—AREOLET OF LABENA GRALLATOR (SAY).

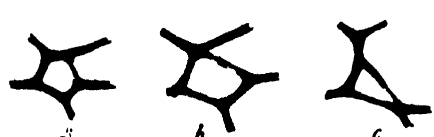
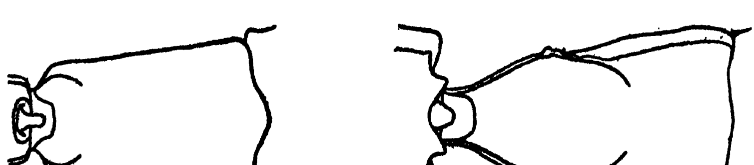


FIG. 11.—AREOLETS: *a*, TROMATOBIA RUFOVARIATA (CRESSON); *b*, ITOPLECTIS CONQUISITOR (SAY); *c*, EPIURUS ALBORICTA (CRESSON).

Not agreeing entirely with above, fig. 11................................ 11.

11. Abdomen sessile (not distinctly tapering from spiracles to base and with prominent anterior lateral angles), very rarely (*Perithous*) clavate and slightly compressed at apex; areolet usually defined; claws rarely without basal tooth; (external parasites on lepidopterous, coleopterous, and hymenopterous larvae and pupae, or in spider egg-sacs), fig. 12..........................*Ichneumonini*.



12. Mandibles edentate at apex, rarely with a small entodorsal tooth; legs slender; fig. 14 .... *Xoridini.*

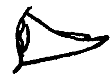


FIG. 14.—MANDIBLE OF POEMENIA AMERICANA (CRESSON).

Mandibles bidentate at apex, the teeth subequal in length; legs stout. *Odontomerini.*

KEY TO TRIBES.

1. Abdomen inserted above, frequently far above, the hind coxae, first tergite narrow throughout; head transverse; occiput narrow, completely margined, barely concave; temples short and strongly convexly sloping; eyes emarginate within; propodeum nearly straight and horizontal from base to insertion of abdomen; hind coxae long, slender and nearly uniform in diameter; thoracic dorsum not at all transversely rugose .... *Labenini.*
   Not agreeing entirely with above .... 2.
2. Mandibles edentate or with a much shorter entodorsal tooth; first tergite petiolate, spiracles before middle; areolet usually wanting; thorax depressed, mesopleura distinctly longer than high; head subquadrate; notauli complete or nearly so. *Xoridini.*
   Mandibles bidentate apically, teeth subequal or upper tooth longer .... 3.
3. Occipital carina wanting or interrupted medially; mesoscutum and scutellum transversely rugose throughout; abdomen inserted rather high or propodeum, occasionally far above insertion of hind coxae; first tergite with spiracles before middle and shorter than or subequal to second, which is parallel-sided. *Rhyssini.*
   Occipital carina complete; mesocutum and scutellum not transversely rugose, at most the mesoscutum partially rugoluse .... 4.
4. Abdomen distinctly compressed in apical third or half, (deeper than broad). *Acoenitini.*
   Abdomen not distinctly compressed .... 5.
5. Abdomen petiolate; head subcubical, swollen below antennae, not, or scarcely, narrowing behind eyes; eyes small and placed well forward, cephalo-candad length of posterior orbits longer than or subequal to that of eye; thorax and propodeum depressed, the latter very long dorsally, short posteriorly; legs, especially the femora, stout; areolet wanting .... *Odontomerini.*
   Not entirely as above, though rarely agreeing with one or two characters .... 6.
6. Tergites, at least 2–4, with oblique furrows which converge anteriorly until they approximate in the dorsal middle .... 7.
   Tergites without such furrows .... 8.
7. Tergites 1–5 in male, 1–4 in female, with apical transverse impressions which together with oblique impressions set off a median, transverse, sub-triangular area; malar furrow present; first tergite with dorsal carinae short; scutellum carinate laterally to apex; intercubitus nearly or quite twice as long second abscissa of cubitus; nervellus strongly inclivous .... *Lycorini.*
   First tergite without either oblique or transverse impressions, and with dorsal carinae extending beyond middle; other tergites usually without transverse apical furrows;[1] scutellum not carinate laterally; intercubitus not nearly twice as long as second abscissa of cubitus; nervellus reclivous, perpendicular, or slightly inclivous .... *Glyptini.*

[1] None of the North American Glyptini have the transverse furrows, but the South American genus *Zaglyptomorpha* Viereck has them on tergites 2-5. This genus, however, has none of the other characters of the Lycorini.

8. Tergites beyond first without either furrows, depressions, or elevated areas; dorsal carinae of first tergite defined at most only very briefly at base (in difficult species the spiracles of first tergite are very close to the base), mesoscutum anteriorly usually with a cuneiform pale spot on each side.............. 9.

Tergites beyond first with more or less distinct elevated areas, depressions, or furrows or combinations of or all of these factors; dorsal carinae of first tergite distinct and setting off of a distinct basal concave area (in the very rare difficult species the spiracle of the first tergite is far from the base).............. 10.

9. Propodeum entirely without carinae; claws strongly curved, with few (about 6) very long, closely set teeth; entire body smooth, at most very minutely punctate...*Phytodietini*.

Propodeum usually with at least an apical transverse carina, rarely without carinae; claws long, weakly curved and if pectinate the teeth are smaller, more numerous, or sparsely set; at least the thorax dorsally and propodeum distinctly sculptured ....*Lissonotini*.

10. Propodeal spiracle slit-like, the surrounding carina prominent, separated from the anterior margin of the propodeum by less than its length; notauli subparallel ending abruptly posteriorly; body smooth and shining, mostly bright ferruginous or yellow; propodeal carinae very strong and high..........*Theroniini*.

Propodeal spiracle round or elongate the surrounding carinae not prominent, removed from the anterior margin of the propodeum by at least its length; notauli obsolete or converging posteriorly; usually sculptured and dark colored, occasionally ferruginous or polished, but rarely both; propodeal carinae obsolete or weak, at least not very high and strong...................... 11.

11. Notauli weak or absent; or if very strong and complete they are deep and pitlike anteriorly and set off by a sharp carina that runs back along the lateral margin of the mesoscutum;[1] head set very close to prescutum; mesopleural furrow straight or curved but not angulate opposite the punctiform fovea...*Ephialtini*.

Notauli usually deep, at least anteriorly; the anterior margin of the mesoscutum distinctly trilobed; head, by reason of the longer pronotum, set off from the prescutum; mesopleural furrow angulate opposite punctiform fovea.... 12.

12. Notauli strongly impressed throughout, prescutum very prominent (if notauli are not strongly impressed, as in *Hymenoepimecis*, the prescutum is nevertheless very prominent and the other characters are especially well marked); temples flat or slightly convex, sloping to the strong occipital carina; face converging below and at least as long as wide at clypeus, the latter convex or slightly flattened, usually rounded at apex and with a reflexed margin, rarely (*Hymenoepimecis*) very weakly, broadly emarginate, never medially impressed or inflexed; mandibles narrow at apex, upper tooth distinctly the longer; scutellum elevated and compressed from the sides; areolet very rarely defined. *Polysphinctini*.

Notauli rarely complete, weakly impressed posteriorly, prescutum not especially prominent (if complete and prescutum prominent, as in *Clistopyga*, the insect differs radically in other characters); temples usually strongly rounded; very rarely flat, less sharply sloping; face usually wider than long; clypeus usually medially impressed and emarginate at apex, sometimes inflexed and truncate or very weakly emarginate; teeth of mandibles subequal in length; scutellum broad, convex, or flattened; areolet usually complete, occasionally wanting or incomplete...*Ichneumonini*.

[1] None of the Holarctic genera have the notauli strong, the genera in which they are strong being principally oriental.

Tribe LISSONOTINI.

As here defined this tribe includes most of the genera placed there by Ashmead and other writers. Of the Nearctic and Palearctic genera *Hybophanes* Foerster and *Phytodietus* Gravenhorst are excluded. *Hybophanes*, we agree with Thomson, is a Tryphonine belonging in the subtribe Thymaridina, tribe Mesoleptini; *Phytodietus* forms the new tribe Phytodietini; while *Phidias*, unknown to us except from descriptions and Vollenhoven's figure, will very likely not run here, and probably should be referred to another subfamily.

The group is very homogeneous, and when once understood is easily recognized. It is very closely allied, especially through *Arenetra* Holmgren, to the Banchini as represented by *Exetastes* Gravenhorst and its nearest allies. The males of some of the Lissonotine genera are likely to be confused with males of the Tryphonines and apparently certain portions of that very heterogeneous subfamily are rather closely related to the present tribe. Within the subfamily as here treated its closest relative is the Glyptini, the abdominal structure being the only real difference, and these two tribes form a group not at all closely related to the rest of the subfamily.

GLYPTINI, new tribe.

The tribe Glyptini is founded for the genus *Glypta* Gravenhorst and its allies, *Teleutaea* Foerster, *Diblastomorpha* Foerster, and *Conoblasta* Foerster. *Ctenochira* Foerster, and *Hoplitophrys* Foerster are unknown to us, but apparently belong here. All of these genera have heretofore been referred to the tribe Ichneumonini.

The remarks above concerning the affinities of the Lissonotini apply in large part to the Glyptini.

LYCORINI, new tribe.

As here defined this tribe includes of described genera only *Lycorina* Holmgren and *Toxophoroides* Cresson. These genera have heretofore been placed in the tribe Ichneumonini, to which they are perhaps more closely allied than to the Glyptini, with which the structure of the tergites superficially allies them. The real affinities of the tribe are very obscure.

PHYTODIETINI, new tribe.

The only genus known to us that is referrable here is *Phytodietus* Gravenhorst, heretofore placed in the Lissonotini. Although superficially resembling the Lissonotini it is doubtful if it is closely allied to that tribe. It may be that it has some affinity with the Lycorini, and the ovipositor suggests the possibility that they may have had a common origin with the Cryptinae.

THERONIINI, new tribe.

Heretofore the genera of this tribe have been placed in the Ichneumonini. As here defined but two genera, *Theronia* Holmgren and *Neotheronia* Krieger, occur in the Holarctic fauna. In the tropical regions certain other allied genera occur.

In the form of the ovipositor and the secondarily parasitic habit the Theroniini are very distinct, though probably more closely allied to the following tribe, Ephialtini, than to any of the other tribes.

EPHIALTINI, new tribe.

The type genus of this tribe is *Ephialtes* Schrank (=*Pimpla* Authors and *Pimplidea* Viereck)[1] while the other genera are *Itoplectis* Foerster and *Apechthis* Foerster, in addition to several tropical and oriental genera, such as *Xanthopimpla* Saussure, *Echthromorpha* Holmgren, and *Allotheronia* Ashmead.

Except in superficial facies the Ephialtini are very distantly related to the Ichneumonini, to which the genera have almost universally been referred.

POLYSPINCTINI, new tribe.

This tribe is erected for the genera *Polyspincta* Gravenhorst, *Acrodactyla* Haliday, *Colpomeria* Holmgren, *Zatypota* Foerster, and *Hymenoepimecis* Viereck, all heretofore assigned to the Ichneumonini.

Their very peculiar habits ally them much more closely than to any of the other tribes of the Ichneumoninae to certain of the Tryphoninae, such as *Monoblastus* Holmgren and *Polyblastus* Hartig. We believe that the facies and biological affinities exhibited by these two groups is of much greater importance as indication of relationship than are the superficial characters of form of abdomen and length of ovipositor.

The following six tribes we believe form the true Ichneumoninae. All are externally parasitic and each is related by more or less intermediate genera or by common characters of structure and hatitus to one or more of the others.

Tribe LABENINI.

Ashmead was the first to recognize this group as a tribe, but in his classification he included also the Ophionine genus *Nonnus* Cresson. As defined here the tribe includes, of described genera, only *Labena* Cresson and *Grotea* Cresson.

RHYSSINI, new tribe.

The only author to teat this group as of tribal rank is Morley, other authors having placed the genera comprising it in the Ichneu-

[1] See Cushman and Rohwer, Proc. Ent. Soc. Wash., vol. 20, (1918) 1919, p. 186.

monini. The only described genera occurring in this region which belong to this tribe are *Rhyssa* Gravenhorst and *Megarhyssa* Ashmead, but in other parts of the world others occur, and all the genera treated by Morley in his tribe Rhyssides appear to belong to the Rhyssini as here defined.

Through *Apechoneura* Kriechbaumer it is related to the Labenini, and, through certain genera of the Xoridini and Ichneumonini to those tribes.

Tribe ACOENITINI.

As here restricted this tribe embraces only those genera which, in the female, have the hypopygidium very long vomeriform and polished. In the Holarctic fauna this includes, of the genera which we have examined, only *Arotes* Gravenhorst, *Coleocentrus* Gravenhorst, *Acoenites* Latreille, *Phaenolobus* Foerster, and *Mesoclistus* Foerster.

Of the genera placed in this tribe we have not had opportunity to examine *Asthenomeris* Foerster. The type of *Asthenomeris* has never been described; but according to Schmiedeknecht the genus is intermediate between the Acoenitini and Banchini. *Crypturus*, synonymous with *Endurus* Rondani, was transferred by Schmiedeknecht to the Tryphoninae, where it forms his subtribe Endurina of the tribe Mesoleptini. This treatment of the genus seems to us the logical one.

Leptobates Gravenhorst and *Procinctus* Foerster we place with the Banchini; *Aphanorhoptrum* Foerster with the Tryphonini, where it is closely allied to *Stilbops* Foerster, removed thence from the Ichneumonini; and *Collyria* Schiødte to the Mesoleptini, where it would form a distinct subtribe.

In biological habits and ovipositor and clypeal characters, together with somewhat similar general form, this tribe is most closely allied to the Rhyssini.

Tribe XORIDINI.

The tribe Xoridini of previous classifications is a very heterogeneous group. As here restricted it inclues of the Holarctic fauna the genera *Deuteroxorides* Viereck, *Xorides* Latreille *sensu latiori* (= *Xylonomus* Gravenhorst), and *Poemenia* Holmgren (= *Calliclisis* Foerster).

The genera *Echthrus* Gravenhorst, *Nyxeophilus* Foerster, *Helcostizus* Foerster, *Xylophruridea* Viereck, (= *Cryptoideus* Ashmead), and *Xylophrurus* Foerster we exclude entirely from the subfamily, placing them in the Cryptinae.[1] *Odontomerus* Gravenhorst and *Aplomerus* Provancher are removed to form the allied tribe Odontomerini. *Helcostizidea* Rohwer, originally placed by its author in

[1] See Cushman, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 536.

the Xoridini, we are agreed is Campopligine and allied to *Pyracmon* Holmgren.

Through *Deuteroxorides* the Xoridini are related to the Rhyssini and through *Xorides* to the Odontomerini.

ODONTOMERINI, new tribe.

Erected for the genera *Odontomerus* Gravenhorst and *Aplomerus* Provancher, this tribe is most closely related to the Xoridini, especially to the genus *Xorides* Latreille.

Tribe ICHNEUMONINI.

From this tribe as treated by Ashmead we have withdrawn the genera constituting the tribes Rhyssini, Lycorini, Glyptini, Polysphinctini, Theroniini, and Ephialtini. Of the Nearctic and Palearctic genera that remain we have had no opportunity to examine specimens of the following: *Troctocerus* Woldstedt, *Atractogaster* Kriechbaumer, *Opisorhyssa* Kriechbaumer, *Idiogramma* Foerster, *Tromera* Foerster, *Eremochila* Foerster, and *Panteles* Foerster. *Stilbops* Foerster, *Dyspetes* Foerster, *Schizopyga* Gravenhorst and *Polyspinctomorpha* Ashmead, are in our opinion Tryphonine, the first belonging to the Tryphonini, the second to the Mesoleptini, and the third to the Exochini; while *Polyspinctomorpha* is Mesoleptine and synonymous with *Neliopisthus* Thomson.[1]

Through *Pseudorhyssa* Merrill this tribe is rather closely allied to the Rhyssini.

[1]Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 378.

DIABANTITE, STILPNOMELANE, AND CHALCODITE OF THE TRAP QUARRIES OF WESTFIELD, MASSACHUSETTS.

By Earl V. Shannon,
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Throughout the Triassic area of the Connecticut Valley the diabasic sills, dikes, and flows are decomposed to a greater or less extent, the most universally common product of this alteration being an earthy deep-green chlorite. Similar chlorites occurring as coloring matter in altered diabases of Frankenwald and Voigtland were early analyzed by Liebe and named diabantachronnyn. In 1875 Hawes[1] analyzed such a chlorite from the amygdaloid trap of the Farmington Hills, Connecticut, deducing a rational formula from four careful analyses made upon pure homogeneous material. Hawes shortened Liebe's ponderous name to diabantite. So far as known to the writer no chemical work on this mineral has since been published. Emerson in his description of the Deerfield Dike,[2] in his Monograph on the Geology of Old Hampshire County,[3] and in the accompanying Mineralogical Lexicon,[4] mentions many and varied occurrences of green chlorite which he referred to diabantite, but he apparently made no chemical analyses. In fact, in the Deerfield paper he remarks as follows: "That the mineral is chemically identical with that analyzed by Hawes and named diabantite by him is extremely probable in view of their identity in all chemical and especially optical properties, and of the monotonous similarity of the many diabase dikes of the Connecticut basin in which both occur. That the mineral is distinct from delessite, as the word is used by Zirkel, Rosenbusch, and Heddle, is much less certain."

During the past year the writer has frequently visited the quarries of the Lane company, in the outcrop of the Holyoke Trap sheet along the west line of the town of Westfield, Massachusetts. These quarries are well known to mineralogists for the many superb specimens of datolite which they have produced. The location of the quarries and the general mode of occurrence of the minerals have been noted in a brief paper published by the present writer after a first visit.[5]

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[1] Amer. Journ. Sci., vol. 9, 1875, p. 454.
[2] Idem, vol. 24, 1882, pp. 198–201.
[3] U. S. Geol. Survey, Mon. XXIX.
[4] U. S. Geol. Survey Bull. 126.
[5] Amer. Mineral., vol. 4, 1919, No. 1, p. 5.

Since then a dozen days spent in careful observation have enabled the list of species known to occur here to be considerably enlarged. Early in the examination, the chloritic decomposition product was noted and many specimens were collected none of which, however, was of sufficient purity to encourage chemical investigation. In January of this year, there was found, in the extreme southeastern corner of the No. 2*a* quarry, a narrow fissure extending upward from the floor of the quarry, on either side of which the trap for a distance of from one to three feet was completely altered to a sandy friable material of deep green color when wet and pale grayish-green when dry, the appearance of the whole suggesting hydrothermal alteration by ascending waters rather than any change dependent upon ordinary surficial weathering agencies. About two-thirds of the distance up the wall this fissure widened into a filled cavity from two to four inches in width. The walls of this cavity were lined with a layer of well developed prismatic quartz crystals averaging 5 mm. in length over and around which was a thick deposit of a green clayey mineral, the remaining space being filled with translucent calcite with a strong twinning tendency. The calcite masses are impregnated by the green mineral for a space of a few millimeters but are for the most part clear. In the narrower portions of the cavity the calcite was absent and the whole of the space between the quartz lining of the two walls was occupied by the green mineral. This substance was of the appearance and consistency of not very plastic clay. When obtained the specimens were saturated with water and frozen and of a bright deep green color. Upon drying, the mineral shrunk remarkably, becoming completely filled with cracks and most of the specimens fell to pieces spontaneously. When dry the color was pale olive green. In all about 6 kilograms of this mineral were obtained, a small part of which had been triturated by movement along the fissure and contained scattered angular fragments and broken crystals of quartz and calcite. Ideally pure material was available in abundance for analysis and several complete analyses were made. The dried mineral can be readily crushed to powder between the fingers. In the closed tube it becomes brown, yields neutral water and finally fuses to a black magnetic glass. It is readily soluble in hot hydrochloric and sulphuric acids and difficultly so in nitric acid in each case with separation of flocculent silica. The specific gravity was found to be 2.77. Under the microscope, this material is seen to be composed of minute micaceous scales of uniform size and wholly irregular outline. Basal plates extinguish between crossed nicols the mineral being sensibly uniaxial and optically negative. It is transparent and exhibits pleochroism in tones from pale brown to moderately deep greenish brown. The mean index of refraction is high for a chlorite, being about 1.62, about the same as that of delessite. While these

analyses differ slightly from those of Hawes on Farmington material they are sufficiently close that the material may be referred to diabantite without question. The results of the analyses are tabulated below:

Analyses of diabantite.

Constituents.	1	2	3	4	Average.
SiO	28.12	27.90	28.50	28.09	28.15
Al_2O_3	15.93	16.13	14.39	14.23	15.17
Fe_2O_3	3.99	3.85	3.91	3.64	3.85
FeO	25.09	25.22	25.28	25.31	25.23
MgO	14.48	14.67	14.35	14.74	14.56
CaO	.78	.53	.56	.50	.59
MnO	.17	.17	.27	.23	.21
$H_2O-105°C$	.40	.63	.64	.62	.57
$H_2O+105°C$	11.02	11.41	11.13	11.44	11.25
Total	99.98	100.51	99.03	98.80	99.58

Some time after the above analyses had been completed, there was found, on the face of the No. 4 quarry, a similar vein containing abundant clayey green material. This vein was not marked by any such pronounced alteration of the walls and its first lining was a crystal crust made up of calcite in peculiar trigonal crystals formed by half of an obtuse rhombohedron truncated by a bright basal plane. Over and around these crystals was the thick layer of clay which varied in color from bright verdigris to olive green. Last here as before came calcite in broad translucent cleavage masses containing cavities lined with nearly cubic rhombohedrons of calcite. This being the second occurrence of fine homogeneous material suited for chemical investigation, which was found, its examination was undertaken in order to determine whether it conformed more closely than did the previous lot to the diabantite of Hawes. Surprisingly enough, this material was found to be entirely unlike diabantite in composition and to be quite clearly referable to stilpnomelane. The structure is in places somewhat platy as though pseudomorphous after some platy mineral or as though it had been deposited between the plates of some mineral now entirely removed. In color it is more bluish than the diabantite, the clayey variety is more plastic, when micaceous it is apparently more opaque and there is a peculiarly submetallic luster, which is wanting in diabantite. In drying these specimens do not develop many shrinkage cracks and the dried material instead of being soft and friable is so compact and tough that it is difficult to pulverize in a mortar. Under the microscope this mineral, like the diabantite, is seen to consist of micaceous scales, imperfectly transparent and pleochroic in tones of light to dark brownish-green. Basal plates are dark

between crossed nicols, the mineral evidently being approximately uniaxial. The birefringence is higher than that of diabantite where the scales lie upon a face perpendicular to the basal cleavage. The optical character is negative. Occasionally a scale shows hexagonal outline and curved vermicular aggregates occasionally occur. The minimum and maximum indices of refraction are approximately 1.560 and 1.575, respectively. The analyses gave the results tabulated below.

Analyses of stilpnomelane, from Lane's No. IV quarry.

Constituents.	I	II	Average.
SiO^2	44.14	44.02	44.08
Al^2O^3	5.24	4.24	4.74
Fe^2O^3	5.21	5.33	5.27
FeO	23.09	23.53	23.31
MgO	8.89	7.84	8.36
CaO	Trace.	Trace.	Trace.
MnO	.88	.87	.87
$H_2O-105°C.$	1.58	2.84	2.21
$H_2O+105°C.$	10.24	11.71	10.28
Total	99.27	100.38	99.12

It was disconcerting to find that in a very large number of occurrences of green chlorite, the only two suitable for accurate analysis belonged to distinctly different species. All specimens were then reexamined, an attempt being made to determine silica if nothing else. This was in many cases possible and the results seemed to show that but the two species were present, that they did not intergrade and that individual specimens were distinctly referable to one or the other and none were either mixtures of the two nor intermediate compounds. Quite early in the investigation a reliable qualitative means of distinguishing these two minerals was found in their behavior when boiled with 1.20 specific gravity nitric acid. Powdered diabantite dissolves slowly without change in the acid while stilpnomelane is wholly oxidized yielding a rust-like brown substance. Through handling many specimens the writer became able to distinguish the two by megascopic features alone. Under the microscope they may be readily distinguished by the difference in refractive index and this means served to classify a number of specimens where the amount of the mineral was insufficient for a chemical examination. In one or two specimens anomalous optical properties served to suggest that a third chlorite might be present or that diabantite and stilpnomelane might be intergrown. Most of the greenish-black varnish-like material on joints and slickensides is diabantite as is most of the very fine-grained green chlorite in the altered rock. In the old No. 1 quarry, many small veins and frac-

tures have a thin layer of fibrous greenish-black material in which as in similar material described by Emerson from Cheapside the fibers are inclined at a small angle to the wall and appear as if combed into position by movement along the fissure. At Deerfield such fibers consist of diabantite and prehnite but at Westfield the fibers are entirely calcite coated externally with diabantite with occasionally a little interstitial stilpnomelane. Many small veins in the upper quarries especially are lined with quartz crystals above which is a layer of deep blackish to bluish-green submetallic stilpnomelane in foliated small-micaceous or beautifully concentric botryoidal surfaces. The series is closed by calcite which is easily separated from the earlier minerals leaving fine broad surfaces of the stilpnomelane exposed. The visibly scaly or micaceous and botryoidal forms are all, so far as tested, stilpnomelane, diabantite being in all cases megascopically structureless. Botryoidal diabantite in amgdaloid is described by Emerson from Larrabee's quarry on the north line of Holyoke. The writer visited this quarry but was unable to find any specimens showing the chlorites in megascopic aggregates. Well characterized stilpnomelane was found in quartz coated by calcite at the quarry at the The Notch still farther north.

Chlorophaeite which was found in the Deerfield trap at Cheapside by Emerson was not observed at Westfield. The chlorophaeite, however, is an alteration product of an early generation of prehnite which does not seem to be represented here. It is interesting at this point to consider the similarity in composition between chlorophaeite and stilpnomelane, the former being not unlike a greatly hydrated and peroxidized variety of the latter. The stilpnomelane displays the same tendency toward oxidation, in less marked degree, as is evidenced by its behavior in nitric acid and in its alteration as discussed below.

From time to time specimens were found in the various quarries which contained micaceous scales of a pure deep golden yellow color and metallic luster. This was supposed to be the diabantite-vermiculite of Emerson but none of the fragments exfoliated when heated. In one place in the No. IV quarry this substance occurred in broad surfaces of foliated and botryoidal aggregates of scales on quartz surmounted by epidote prehnite and calcite. The superposed minerals were easily separated from the golden coating which had exactly the form and structure of the stilpnomelane of other parts of the quarry, but appeared precisely as though coated with commercial gilt paint. None of this material showed the characteristic exfoliation of a vermiculite. Though abundantly present this mineral was of exceedingly small bulk, and it was found to be impossible to secure enough

for an analysis. A very minute amount of pure material gave 45.77 per cent of silica, strong qualitative tests for ferric iron, no ferrous iron, and very small amounts of alumina and magnesia. In one or two specimens the interiors of lumps of this golden substance were still green and contained ferrous iron. Later a specimen was found in the collection of William Fitts, of Springfield, which contained more of the yellow mineral than any found at the quarries. Some small lots of the mineral taken from this specimen were analyzed, and the results of the analyses after deducting calcite indicated that it was essentially of the composition of stilpnomelane in which the ferrous iron is completely oxidized to ferric iron and the hydration is increased by the addition of hygroscopic water. It will thus be seen that in physical characters and chemical composition it is essentially identical with the chalcodite of Shepard.[1] Shepard included under this head also the associated green material high in ferrous iron which Brush[2] has shown to correspond to stilpnomelane. Brush attempted to include all chalcodite under stilpnomelane, but it now appears that stilpnomelane is the wholly ferrous chlorite, while the varietal name chalcodite should be restricted to the golden ferric alteration product and indeterminate intermediate minerals containing varying amounts of iron in both states of oxidation are merely transition products in the change of stilpnomelane to chalcodite. The samples analyzed gave the following results:

Analyses of chalcodite, Westfield.

Constituents.	1	2
SiO_2	44.64	48.16
Al_2O_3	6.75	30.11
Fe_2O_3	23.59	
MgO	9.86	4.43
$H_2O-105°$ C.	6.21	3.97
$H_2O+105°$ C.	7.14	7.10
Total	98.19	93.77

The material was not of sufficient purity nor in sufficient amount to permit very exact analytical work, and the results give no sufficiently reliable basis for speculation as to the exact chemical nature of or the correct formula for chalcodite. For the present it must be regarded as an indefinite oxidation product of stilpnomelane. Under the microscope the material is micaceous and partly transparent. The scales lie upon the flat face and are dark in all positions between crossed nicols. The mean index of refraction is about 1.64, but

[1] Shepard, Rep. Amer. Assoc. Adv. Sci., vol. 6, 1851, p. 232.
[2] Brush, Amer. Journ. Sci., vol. 25, 1858, p. 198.

varies slightly in different specimens. The minute scales vary in color and transparency and appear as though dusted with a submicroscopic brown pigment, quite probably limonite, which has separated out in the process of oxidation.

In a recent paper Emerson [1] gives a brief description of specimens from this locality, in which he mentions crystal cavities or molds of anhydrite now entirely removed. In some cases the anhydrite has been replaced, he writes, by diabantite, which has altered to diabantite-vermiculite and then to limonite. Many specimens of these flat negative crystals are included in the writer's collections from these quarries. The hollow cavities are of several forms which are not all of the same age. So far as can be determined from these specimens the chloritic mineral is all stilpnomelane and the golden product of its alteration, as above mentioned, is chalcodite and not a vermiculite. The complete change to limonite was not observed, although when very fine grained the chalcodite might readily be mistaken for limonite. Judging from the fact that the interior surfaces of the stilpnomelane pseudomorphs are always clear and sharp where the anhydrite or other mineral has been removed with no rounding of angles, etc., and the exterior of the stilpnomelane crust is indistinct and irregular the writer has regarded the stilpnomelane as having encrusted the crystals of the removed mineral without replacement. The penetration along cleavage planes where it occurs is in laminae so sharp and uniform in thickness as to suggest simple filling of cleavage cracks opened by strains. The crystal cavities and molds will be described more fully in a later paper on the paragenesis and miscellaneous minerals which with a paper on the crystallography of the datolite will conclude this series.

It may be well here to state the nomenclature used in designating the quarries. Going north from the Boston and Albany Railroad these are numbered 1–1*a*, 2–2*a*, 3–3*a*, and 4 respectively, this being substantially the designation used by the quarrymen who include the two openings each of the first, second, and third quarries under the single number.

The type material described above has been deposited in the United States National Museum, catalogue numbers as follows: Diabantite 93440, 93441; stilpnomelane 93447, 93438; chalcodite 93442.

[1] Emerson, Amer. Journ. Sci., vol. 42, 1916, p. 233.

THE NORTH AMERICAN ICHNEUMON-FLIES OF THE TRIBES LABENINI, RHYSSINI, XORIDINI, ODONTOMERINI, AND PHYTODIETINI.

By S. A. Rohwer.

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This paper, which is a contribution from the Branch of Forest Insects, Bureau of Entomology, is based on the collections in the United States National Museum but the types which are in other American collections have been examined and notes on them have been used in the discussion of the species. The types of all new species are in the National Museum. In the tribe Labenini notes on all the material in the National collection have been included but in the other groups the notes and keys include only the species found north of Mexico.

The definition and limits of the tribes used in this paper is the same as those proposed by Cushman and Rohwer.[1] All of the drawings were prepared, under the writer's supervision, by Miss Mary Carmody, formerly of the Branch of Forest Insects, Bureau of Entomology.

Tribe LABENINI Ashmead.

Labenini Ashmead, Proc. U. S. Nat. Mus., vol. 23, 1900, p. 48, (part).
Labenini Schmiedeknecht, Gen. Insect., fasc. 62, 1907, p. 94, (part).
Labenini Cushman and Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 394.

Ashmead was the first writer to propose a tribe for these American insects, but the tribe as originally defined by him included also the Ophionine genus *Nonnus* Cresson. Schmiedeknecht followed Ashmead in including *Nonnus* in the Labenini but this is undoubtedly due to the fact that he did not know the genus (under that name) because he had redescribed it, as pointed out by Viereck,[2] under the name *Ophionocryptus*.

The tribe Labenini is very distinct, yet recalls through *Labena* Cresson the Rhyssini and through *Grotea* Cresson there is a suggested affinity to some Ophioninae. The larvae are externally parasitic on larvae which live within woody tissue. *Labena* is parasitic on wood-boring Coleoptera, while *Grotea* is parasitic on bees and wasps and at least in some instances is phytophagous through part of its life.

[1] Proc. U. S. Nat. Mus., vol. 57, 1920, p. 379.
[2] Idem, vol. 46, 1913, p. 377.

In this tribe the author has based his studies on all of the available material and has therefore included notes and descriptions of Mexican and West Indian species.

Tribal characters.—Head transverse; occipital carina complete, well-defined; inner margins of eyes emarginate; malar space narrow; clypeus well-defined dorsally; antennae long; mesoscutum long, produced anteriorly, both it and the scutellum without transverse striae or rugosities; propodeum more or less areloated; hind coxae slender, elongate, as long as the hind femora; tarsal claws simple; areolet large, pentagonal; disco-cubitus not strongly curved or angulate; nervulus interstitial or nearly; nervellus perpendicular or reclivous broken at about the middle; abdomen inserted above the hind coxae, petiolate, somewhat compressed and thickened apically; ovipositor well exserted, more or less compressed, without a notch on the dorsal margin, apically with oblique ridges or furrows; hypopygidium not reaching the apex of the abdomen.

TABLE TO THE GENERA.

1. First tergite bent upwards beyond middle and almost twice as long as the hind coxae; prepectal carina terminating below the middle of the mesepisternum which is much longer (cephalocaudad) than high; ovipositor about half as long as the abdomen; cheeks armed; clypeus curved dorsally, short, not depressed apically; head distinctly narrowed behind eyes..............*Grotea* Cresson.
   First tergite straight, subequal in length with the hind coxae; prepectual carina terminating above the middle of the mesepisternum which is higher than long; ovipositor at least nearly as long as abdomen.......................... 2.
2. Cheeks produced into a broad tooth posteriorly; clypeus short, not depressed apically, its dorsal margin strongly curved; face smooth, feebly punctured; head distinctly narrowed behind the eyes; third antennal joint subequal in length with fourth and fifth combined..................................*Labenidea* Rohwer.
   Cheeks unarmed; clypeus long, depressed from above the middle, its dorsal median straight; face roughened; head not receding posteriorly; third antennal joint much shorter than fourth and fifth combined.................*Labena* Cresson.

Genus LABENA Cresson.

Labena Cresson, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 399. *Genotype.*—*Cryptus grallator* Say (Viereck, 1914).

Dyseidopus Kreichbaumer, Ann. k.k. Naturh. Hofm. Wein, vol. 5, 1890, p. 489. *Genotype.*—*Dyseidopus sericeus* Kreichbaumer. (Monobasic.)

Species which belong to the genus *Labena* have been referred to *Cryptus* (by Say) and *Mesochorus* (by Brullé) but since the description of the genus in 1864 it has been correctly recognized by most authors. The genus *Dyseidopus* Kreichbaumer is synonymized after a study of the original description and is supported by the observations of Krieger published in 1903.

The genus *Labena* although very distinct has a habitus and many characters which suggest the Rhyssine genus *Apechneura* Kriechbaumer and more especially the subgenus *Paraneura* Morley. As far as known all of the species are parasitic on wood-boring Coleoptera.

Generic characters.—Head, as seen from above, rectangular in outline, not narrowed posteriorly; eyes large, their inner margins emarginate above the antennae; posterior orbits somewhat less than half the cephalo-caudad diameter of the eye, broader below; clypeus long, depressed above the middle and clothed with hairs; clypeal suture straight; face more or less roughened and often with a medium carina or tubercle; third antennal joint much shorter than the fourth and fifth joints combined; prepectal carina extending well above the middle of mesepisternum; mesepisternum higher than cephalo-caudad length; the scutum long and without notauli; scutellum not margined; propodeum areolated, sharply separated from the metanotum by a furrow, but not separated laterally from the metapleura; propodeal spiracle slit-like and well removed from the base; the first tergite straight and subequal with the hind coxae; ovipositor at least nearly as long as abdomen, compressed, straight below, tapering dorsally at apex, without a notch, and apically with oblique ridges; four anterior tibiae somewhat twisted; hind coxae slender, elongate almost as long as the femora or first tergite; apical joint of hind tarsi curved subequal in length with the three preceding joints; claws strongly curved; onychia prominent; nervellus perpendicular, angularly broken slightly above the middle.

Color used in a broad way, the general sculpture and the relative length of the chitinized base part of the first sternite offer the best specific characters. The areolation of the propodeum is subject to such variation that it can not be used as a specific character and it is doubtful if it can be relied upon even when used as loosely as it is in the following key. Most of the Nearctic species are very closely allied and subject to much variation as to details of color markings. The characters presented in the following key have been found to be satisfactory for the material examined.

KEY TO THE SPECIES IN THE UNITED STATES NATIONAL MUSEUM.

1. Body entirely smooth and polished; face with prominent lateral and median carinae .... 2.
   At least with distinct, though scattered punctures on the thorax; no dorsad-ventrad carinae on the face along the eye margins .... 3.
2. Propodeum with a black band basally; sides of the thorax marked with black; male .... *trilineata* Ashmead.
   Propodeum and sides of thorax yellowish; female .... *gloriosa* Cresson.
3. Body entirely black .... *nigra* Rohwer.
   Body largely or entirely ferruginous or rufoferruginous .... 4.
4. Body entirely rufo-ferruginous without markings; wings yellowish-hyaline with the apical margin dusky .... *tinctipennis* Rohwer.
   Body ferruginous with black and yellowish markings; wings either entirely or in the greater part brownish or in the males hyaline with a dusky margin .. 5.
5. Rather slender; chitinized basal part of the first sternite extending to or beyond a line drawn tangent to the caudal margin of the spiracle; basal area longer than wide or with the length and width subequal .... 6.

More robust; chitinized basal part of the first sternite not extending beyond a line drawn tangent to anterior margin of the spiracle; basal area usually much wider than long .... 7.

6. Wings uniformly brownish, or nearly so; stigma dark brownish-ferruginous; larger. *grallator* (Say).

Wings largely hyaline with the apical margin dusky; stigma ferruginous; smaller; females placed here have brownish wings with spot in discal area. *apicalis* Cresson.

7. Large, fully 16 mm., with brownish-ferruginous color..........*confusa* Rohwer.

Smaller, not more than 12 mm., color of female clear ferruginous. *confusa* var. *minor* Rohwer.

LABENA TRILINEATA Ashmead.

Labena trilineata ASHMEAD, Proc. Zool. Soc. London, 1895, p. 781.

Type.—Cat. No. 6592, U.S.N.M.

Eyes distinctly closer together at clypeus than at vertex; face transversely rugose with a distinct median dorsad-ventrad carina and with distinct carina along the eye margins; body entirely smooth and polished; basal area slightly longer than wide; chitinized basal part of the first sternite extending a little beyond a line drawn tangent to the caudal margin of the spiracle.

This species, which is represented only by the unique type male, is closely allied to *gloriosa* Cresson.

St. George's (leeward side), Grenada, West Indies (H. H. Smith).

LABENA GLORIOSA Cresson.

Labena gloriosa CRESSON, Proc. Acad. Nat. Soc. Phila., 1873, p. 412.

Type.—Cat. No. 647, Acad. Nat. Sci. Philadelphia.

Eyes distinctly nearer together at the clypeus than at the vertex; face transversely rugose, with a distinct median dorsad-ventrad carina and with distinct carinae along inner eye margins; body yellowish, smooth and polished; basal area wider than long; wings hyaline with apical margin dusky; venation including stigma, dark brown; chitinized basal part of first sternite ending distinctly before a line drawn tangent to the anterior margin of spiracle; ovipositor distinctly shorter than abdomen.

This species was originally described from one female from Mirador, Mexico, but has since been recorded from Peru. A single female from "Mexico" is in the National Collection. Notes from type and specimen in Museum collection.

LABENA NIGRA, new species.

This species is remarkably distinct from the other species of the genus in color.

Female.—Length, 10 mm.; length of ovipositor, 6.5 mm. Eyes somewhat closer together at the clypeus than at the vertex; face transversely wrinkled and also with some distinct punctures, with a nearly complete, distinct, median, dorsad-ventrad carina but with-

out carinae along inner eye margins; vertex and posterior orbits smooth and polished; ocellar triangle not quite equilateral; postocellar line subequal with the ocellocular line; sides of pronotum and the scutum with close distinct punctures; punctures on scutellum, propodeum and mesepisternum more widely separated, the dorsal part of mesepisternum being almost without punctures; basal area not sharply defined posteriorly, its width a very little greater than its length; areola with its length and greatest width (which is somewhat anterior to middle) subequal; abdomen smooth and polished; the chitinized basal part of the first sternite terminating distinctly before a line drawn tangent to the anterior margin of the spiracle; ovipositor as long as abdomen. Black; palpi, clypeus and scape beneath yellowish; base of mandibles and a spot on posterior orbits beneath rufo-piceous; antennae brownish with a broad yellowish annulus between middle and apex; legs yellowish, coxae, posterior trochanters and femora black; wings hyaline with the apical margin dusky; venation dark brown, stigma yellowish; ovipositor sheaths brownish, yellowish at base.

Male.—Length, 13 mm. Chitinized basal part of first sternite terminating beyond a line drawn tangent to the posterior margin of spiracle; otherwise structure much as in female; differs from female in color thus: clypeus, face except a dorsal median spot, elongate spot on posterior orbits, spot on lower margin of pronotum and four anterior coxae beneath yellow; antennae brownish, paler basally and without annulus; stigma brownish.

Paratype males show the face may be entirely yellow.

Type locality.—Bermuda Islands, West Indies. Described from one female (type) and four males (one allotype) collected May 1 and 10, 1909, by F. M. Jones.

Type.—Cat. No. 22134, U.S.N.M.

LABENA TINCTIPENNIS, new species.

The bright rufo-ferruginous color and the color of the wings make this species easily distinguished from the other Nearctic species. The original description of *rufus* (Brullé) suggests that this species is allied to *tinctipennis*.

Female.—Length, 18 mm.; length of the ovipositor, 13 mm. Distance between the eyes at the clypeus very little less than at the vertex; face transversely wrinkled on an opaque surface, without a distinct median carina or tubercule, no lateral carinae but with two oblique low, rounded ridges from clypeus to near eye margin; vertex and posterior orbits polished, smooth; ocelli in a low triangle; postocellar line longer than ocellocular line; interocellar area raised and parted by a median furrow; thorax shining, with distinct, widely separated punctures; mesepisternum dorsally practically inpunctate;

propodeal carinae strong; basal area more than two times as wide as long; areola distinctly wider than long, costulae received behind middle; abdomen smooth and shining; first tergite subpetiolate; chitinized basal part of first sternite terminating before a line drawn tangent to the anterior margin of the spiracle; ovipositor as long as abdomen. Entirely rufo-ferruginous; apices of antennae brownish; wings yellowish hyaline with the apical margin dusky; venation, including stigma, practically the color of the wing; ovipositor and sheath yellowish with brownish apex.

Type locality.—Webber Creek, California. Described from one female collected on *Alnus rhombifolia*, February 6, 1915, by F. B. Herbert.

Type.—Cat. No. 22135, U.S.N.M.

LABENA GRALLATOR (Say).

Cryptus grallator SAY, Boston Journ. Nat. Hist., vol. 1, 1836, p. 236.

Mesochorus fuscipennis BRULLÉ, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 250.

Labena grallator CRESSON, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 400.—WALSH, Trans. St. Louis Acad. Sci., vol. 3, 1873, p. 62.

The type of *grallator* Say is lost but the species was first recognized by Cresson and the specimen in Academy Natural Science, Philadelphia, bearing the name label in Cresson's hand is considered as the neotype of this species. The type of *fuscipennis* (Brullé) has not been examined, it is probably in the Paris Museum.

It is impossible to say that *fuscipennis* (Brullé) is a synonym of *grallator* as here defined, but since other authors have considered it the same it seems best to treat it as such until the type has been studied.

The wings of *grallator* are uniformly dark brown in both sexes and the stigma is brownish-ferruginous; the antennae are without a distinct annulus although in some females they are paler in the middle; ovipositor subequal in length with the abdomen. The areolation of the propodeum is subject to considerable variation but in the specimens examined the basal area is longer than wide or the length and width are subequal.

Distribution.—Discussion of species based on neotype and on specimens from New Orleans, Louisiana, (Shufeldt); Texas (Belfrage); St. Louis, Missouri (Riley); Lawrence, Kansas (Hugo Kahl); Centerville, Jacksonville (Ashmead), Biscayne, Florida; Washington, District of Columbia; Highspire, Pennsylvania (W. S. Fisher); and West Cliff, Colorado (T. D. A. Cockerell).

Hosts.—Walsh records rearing this species from hickory at the same time as he reared *Cesrasphorus cinctus* Fabricius and this has, therefore, been considered as a host for the species. The record is not entirely satisfactory. Chittenden records *grallator* as a parasite

of *Chrysobothris femorata* Fabricius and this seems to be a correct association.

LABENA APICALIS Cresson.

Labena apicalis CRESSON, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 402.

Type.—Cat. No. 1532, Acad. Nat. Sci. Philadelphia, a single male without a head.

This species is very closely allied to *grallator* Say and it is not unlikely that when more material is available it will be found impossible to retain this name. The characters given in the above key will, however, distinguish the specimens examined. The species is smaller and has paler wings than *grallator*, but has much the same range and is subject to about the same variation in the carination of the propodeum.

Distribution.—The *type locality* is Delaware, but besides the type, specimens have been examined from the following localities: Texas (Belfrage); Dallas (F. C. Bishopp), Paris (C. T. Brues) and Victoria (J. D. Mitchell), Texas; Lawrence, Kansas (Hugo Kahl); and Pregnall, South Carolina (Fiske).

Host.—Riley and Howard have recorded this species as a parasite of *Chrysobothris femorata* Fabricius, but the specimen which formed the basis of this record is here referred to as *confusa* var. *minor* Rohwer. A male and female were reared from the galleries of *Lixus scrobicollis* Boheman in *Ambrosia trifida* by J. D. Mitchell (Hunter No. 219). One male reared by J. D. Mitchell from stems of *Verbesina virginica* infested by *Lixus scrobicollis* Boheman (Hunter No. 1397).

LABENA CONFUSA, new species.

This species is very similar to *grallator* (Say) but can be separated from that species by the characters used in the above key.

Female.—Length 16 mm., length of ovipositor 12 mm. Distance between the eyes and the clypeus practically the same as at the vertex; face transversely roughened, without distinct carinae, tubercles or folds; vertex and posterior orbits smooth, polished; ocelli in a low triangle; postocellar line much longer than the ocellocular line; postocellar furrow distinct; interocellar area convex and deeply parted by a median furrow; thorax with close, distinct punctures which are more widely separated on the propodeum and dorsal part of mesepisternum; propodeal carinae strong; basal area about twice as wide as long; areola longer than wide, receiving costulae before the middle; anterior margin of propodeal spiracle strongly curved; abdomen subpetiolate, shining, without sculpture; chitinized basal part of first sternite terminating a short distance before a line drawn tangent to the anterior margin of the spiracle; ovipositor subequal in length with abdomen. Ferruginous with yellowish and blackish marks; orbits, spot on tegulae, line below, hind

margin of mesepisternum and apical margins of second to fifth tergites yellowish; a band across vertex, thoracic sutures and base of first four tergites blackish; antennae ferruginous, dusky at base above; legs ferruginous with the hind femora somewhat piceous and the tibiae somewhat yellowish; wings subhyaline, more or less brownish basally, along the veins and the apical margin brownish; venation dark brown, stigma somewhat more ferruginous.

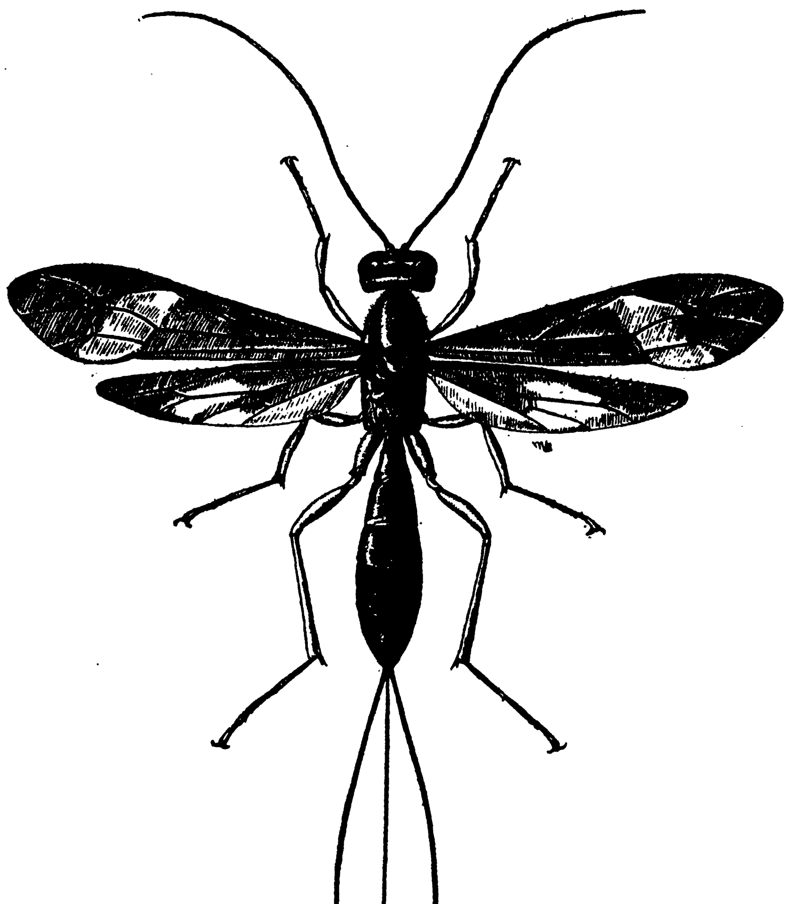

FIG. 1.—FEMALE OF LABENA CONFUSA ROHWER.

Paratypes have the ferruginous color brighter and the black and yellow markings more sharply contrasting and the wings almost completely brownish.

Type locality.—Texas. Described from fourteen females, three (one type) reared by F. M. Webster as parasites of *Thrincopyge alacris* LeConte. Other Texas specimens come from the Belfrage collection, from Paris (F. C. Bishopp) and Dallas (Schwarz); Meta-

comba Keys, Florida (G. N. Collins); Bluemont, Virginia (S. A. Rohwer); Linglestown (H. B. Kirk), Camphill (W. S. Fisher), Pennsylvania.

Type.—Cat. No. 22136, U.S.N.M.

This species has also been reared as a parasite of *Chion cinctus* specimens collected at Mount Vernon, Virginia, by F. C. Craighead.

LABENA CONFUSA var. MINOR, new variety.

This form is much like *confusa,* but is decidedly smaller and the ferruginous color is brighter.

Female.—Length, 12 mm.; length of ovipositor, 8 mm. Distance between the eyes at the clypeus less than at the vertex; wings brownish with a subhyaline oblique band below the stigma; venation dark brown, stigma ferruginous; otherwise much as in *confusa.*

Type locality.—Washington, District of Columbia. Described from four females (one type), three from Washington, one labeled as from *Chrysobothris femorata* Fabricius, and the other from Texas (Belfrage).

Type.—Cat. No. 22137, U.S.N.M.

LABENIDEA, new genus.

Genotype.—*Grotea superba* Schmiedeknecht.

This new genus, while perhaps more closely allied to *Labena* Cresson, has many of the characters of *Grotea* Cresson. The habitus, thorax, and abdomen are more like *Labena,* while the head, especially the dentate cheeks, the clypeus and antennae, is more like *Grotea.*

Generic characters.—Head transverse, distinctly narrowed behind the eyes; cheeks produced into a tooth posteriorly; inner margins of eyes distinctly emarginate opposite antennae; labrum exserted; clypeus transverse, the apical part not depressed, truncate, the dorsal suture strongly curved medianly; the third antennal joint subequal with the fourth and fifth combined; face finely punctured; scutum long and without notauli; scutellum not margined; propodeum partly areolated, sharply separated from the metanotum by a deep furrow, not separated from the metapleura, spiracle curved, slitlike; prepectal carina terminating well above the middle of the anterior margin of mesepisternum; mesepisternum higher than the cephalocaudad length; first tergite straight and subequal in length with hind coxae; ovipositor longer than the abdomen, compressed, tapering apically on both dorsal and ventral margins, apex with oblique furrows; hind coxae slender, elongate, almost as long as hind femora or first tergite; legs long, tibiae not twisted; apical joint of the hind tarsi not especially lengthened and shorter than the two preceding; claws long, bent at almost a right angle apically; onychia very prominent; nervellus reclivous, broken at about the middle.

LABENIDEA SUPERBA (Schmiedeknecht).

Grotea superba SCHMIEDEKNECHT, Gen. Insect., fasc. 62, 1907, p. 95, pl. 1, fig. 8.

This is very probable the same as *Pimpla gayi* Spinola.

Discussion based on one female and one male collected in Chile by E. C. Reed.

It seems probable that *Atractodes lineata* Brullé also belongs to this genus.

Genus GROTEA Cresson.

Grotea Cresson, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 397. *Genotype.*—*Grotea anguina* Cresson. (Monobasic.)

Cameron[1] when he placed both *Nonnus* and *Grotea* in the Ophioninae without giving any reasons, is the only author who considered that this genus was not allied to *Labena* Cresson. Krieger[2] transfers *Atractodes lineatus* Brullé to *Grotea*, but since it is evident that Brullé did not correctly understand the genus *Atractodes* we can not justly consider that he would place *Grotea* in the group to which this genus belongs.

Although the genus *Grotea* is very distinct, and when once known easily recognized, there can be but little doubt that it is allied to *Labena*. This relationship is made more certain by the genus *Labenidea*, which is more or less intermediate between the two.

Generic characters.—Head subtransverse, distinctly narrowed behind the eyes; cheeks produced into a broad tooth posteriorly; inner margins of the eyes subparallel but distinctly emarginate opposite the antennae; face smooth, sparsely punctured; labrum distinctly exserted; clypeus transverse, the apical margin truncate, not depressed, the dorsal margin strongly curved medially; the third antennae joint longer than the fourth and fifth combined; mesocutum very long, without notauli, the anterior wings attached opposite the posterior margin; scutellum convex, more or less pillow-like; prepectal carina well defined but terminating well below the middle of the anterior margin of the mesepisternum; mesepisternum without depressions, much longer (cephalo-caudad) than high; propodeum partly areolated, rather long, depressed below the level of the metanotum; propodeal spiracle elongate, the inner margin curved; the first tergite almost twice as long as the hind coxae, bent upwards beyond the middle; ovipositor about half or less as long as the abdomen, somewhat compressed, tapering apically on both dorsal and ventral margins, and with oblique furrows apically; hind coxae slender, elongate, subequal in length with the hind femora but much shorter than the first tergite; legs of normal length, the tibiae simple; apical joint of the hind tarsi not especially lengthened, shorter than the two preceding joints; claws rather stout, long, sharply bent

[1] Biol. Central Amer. Ins. Hym., vol. 1, 1886, p. 309. [2] Zeit. Hym. Dipt., vol. 3, 1903, p. 290.

apically; onychia prominent; nervellus reclivous, broken at about the middle.

The species of *Grotea* are all very closely allied and the only means of distinguishing them are slight differences in color. There are, however, some differences in the shape and size of the basal area and it may be that when more specimens are available it will be possible to state definitely if these differences can be considered as specific. It would not, however, be surprising if more material would prove that all the species should be combined. The following key is based entirely on the females, as males of only one of the forms are in the collection.

TABLE TO THE SPECIES.

1. Abdomen brownish dorsally, especially apically, wings without a dusky spot. *anguina* Cresson.
   Abdomen uniformly ferruginous, not darkened apically .... 2.
2. A dusky spot along apex of radial vein .... *fulva* Cameron.
   No dusky spot along apex of radial vein .... 3.
3. Length 12 mm.; uniformly pale honey-yellow; wings clear hyaline with contrasting black venation .... *mexicana* Cresson.
   Length 17 mm.; with some yellowish and blackish markings on a ferruginous surface; wings very slightly dusky .... *californica* Cresson.

GROTEA ANGUINA Cresson.

Grotea anguina CRESSON, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 398.—GRAENICHER, Ent. News, vol. 16, 1905, p. 44.

Type.—Cat. No. 1533, Acad. Nat. Sci. Philadelphia.

In the type of this species the basal area is about twice as long as the basal width and narrows apically. This is the shape of the basal area of all the specimens in the national collection, but in the paratype female (No. 1533.2) which comes from New York, the basal area is fully twice as wide as long and not convergent posteriorly.

Distribution.—*Grotea anguina* is represented in the National collection by females only. These come from the following localities: Falls Church, Virginia (N. Banks); Beltsville, Maryland (J. R. Malloch); Ocean Grove, New Jersey; New York; Hartford, Connecticut; St. Louis, Missouri (Phil Rau); Brownsville, Texas (C. H. T. Townsend). Cresson records the species from New Jersey (type locality) and New York, while Graenicher records it from Wisconsin.

Host.—In the original description Cresson records the rearing of this species "from a Rasberry stem, together with a small species of *Crabro*" and in an interesting paper in 1905 Graenicher[1] records it as a parasite of *Ceratina dupla* Say. According to Graenicher this species is both carniverous and phytophagus as it consumes both bee larvae and the "bee-bread" stored by the mother bee. Graenicher also notes that the *Grotea* larva destroys two or three bee cells.

[1] Ent. News, vol. 16, 1905, p. 44.

GROTEA FULVA Cameron.

Grotea fulva CAMERON, Biol. Central Americana, Ins., vol. 1, 1886, p. 309, pl. 12, fig. 27.

Type.—British Museum Natural History.

This species, which was described from specimens collected at Presidio, Mexico, is, because of the dusky spot along the apex of the radius, probably the most distinct species. A single female from San Rafael, Jicoltepec, Mexico, is in the United States National Museum, and has the following characters: Basal area converging posteriorly, one-third longer than basal width; length, 18 mm.

GROTEA MEXICANA Cresson.

Grotea mexicana CRESSON, Proc. Acad. Nat. Sci. Phila., 1873, p. 413.

Type.—Cat. No. 648, Acad. Nat. Sci. Philadelphia.

Paratype.—Cat. No. 13286, U.S.N.M.

The clear wings and pale color as well as the size seem to separate this form from *californica*. In the type, as well as all other specimens examined, the basal area is nearly parallel-sided and about one-third longer than the basal width.

Known only from Orizaba, Mexico.

GROTEA CALIFORNICA Cresson.

Grotea californica CRESSON, Proc. Acad. Nat. Sci. Phila., 1878, p. 370.

Type.—Cat. No. 1534, Acad. Nat. Sci. Philadelphia.

In the type the basal area slightly converges posteriorly and is only a little longer down the middle than the basal width, while the apical transverse carina is sharply angulate (towards the head) medianly. In the female referred to below the basal area is similar. Two males of this species have the basal area similar but differ from the female in having the apical tergites dusky.

Distribution.—Originally described from one female collected in California by H. Edwards. A male and female from Los Angeles and a male from Alameda County, California, all collected by D. W. Coquillett are in the National collection.

Tribe RHYSSINI Cushman and Rohwer.

Rhyssides MORLEY, Rev. Ichn. Brit. Mus., pt. 2, 1913, p. 2.
Rhyssini CUSHMAN and ROHWER, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 394.

Morley was the first author to recognize this tribe and in characterizing it laid special stress on the "Strongly transcarinate mesonotum." While this character is very useful it is believed that the defining characters of the tribe as given by Cushman and Rohwer are more reliable and these authors use the commonly accepted ending for tribes.

The members of the tribe Rhyssini have usually been placed in the tribe Ichneumonini (olim Pimplini) but in minor characters and in

biological habits they seem to be more closely allied to the Xoridini. In the classifications used by Ashmead and others it is impossible to satisfactorily place a Rhyssine in the tribe Ichneumonini because the tergites lack the impressions and strong punctures.

All of the species which have been reared are parasitic on wood-boring larvae and most of the records indicate that they prefer the larvae of horntails. A few observers have recorded the hosts as some wood-boring Coleopterous larvae but all of these are without positive proof and in case of the records from *Monohammus* it seems that they can be discarded. The records of *Serropalpus* can not be so easily discredited because the larvae of members of this genus are usually associated with the larvae of horntails.

Tribal characters.—Head large, transverse, well developed behind the eyes; the posterior orbits margined at least below, the occiput immargined; clypeus transverse, well-defined above; malar space present; malar furrow wanting; mandibles bidentate, the upper tooth broad; eyes slightly converging below; pronotum vertical; scutum prominent, transversely rugose; notauli wanting or incompletely defined; scutellum transversely rugulose; propodeum rather short, the spiracle well removed from base; legs rather long and slender; claws simple; areolet variable; nervellus strongly reclivous and broken far above the middle; abdomen long, often parallel sided in the male; first tergite without prominent carinae, shorter than the second and with the spiracle well before the middle; ovipositor long; apical tergite of female prominent, triangular in outline; hypopygidium small, not prominent.

The shape of anterior margin of the clypeus, the character of the frons, the areolation of the propodeum, the size and position of the propodeal spiracle, the position of the first tergal spiracle, the fusion of the first sternite with the tergite, the emargination of the apical tergites and the position of the nervulus offer the best generic characters. The presence or absence of the areolet has often been used as a primary generic character but that this can not be used as such is abundantly proven by the fact that in some specimens it is completely wanting on one wing while on the other wing it is well defined. The following table is based on the Nearctic genera but the genus *Epirhyssa* Cresson is included as it has often been misinterpreted and has never been well characterized.

TABLE TO THE GENERA.

1. Clypeus with a median tooth; first sternite completely separated from the first tergite; second sternite of female with two median tubercules near the middle; nervulus postfurcal; tergites not at all emarginate posteriorly

Rhyssa Gravenhorst.

Clypeus truncate; first sternite fused with the first tergite basally; second sternite of female with the median tubercules close to the base; apical tergites at least in the male more or less emarginate posteriorly .... 2.

2. Spiracles of the first tergite at about the basal third, the distance between them less than the distance from one to the anterior margin of tergite; second tergite without distinct lunulae; nervulus instertital; areolet wanting; abdomen of male slightly widening posteriorly a little more than twice as long as head and thorax. *Epirhyssa* Cresson.

   Spiracles of the first tergite close to the base, the distance between them greater than the distance from one to the anterior margin of the tergite; second tergite with distinct lunulae; nervulus postfurcal; abdomen of the male practically parallel-sided and three or more times as long as the head and thorax.... 3.

3. Propodeal spiracle about two and one-half times as long as wide and about three times its length from the base of the propodeum; tergites three to five not or but slightly emarginate posteriorly; small or medium size black species. *Rhyssella* Rohwer.

   Propodeal spiracle three or more times as long as wide and about twice its length from the base of the propodeum; tergites three to six deeply angulately emarginate posteriorly; large or medium size usually yellowish species. *Megarhyssa* Ashmead.

Genus RHYSSA Gravenhorst.

Rhyssa GRAVENHORST, Ichn. Eur., vol. 3, 1829, p. 260. *Genotype.—Ichneumon persuasorius* Linnaeus.

Cryptocentrum KIRBY, W. Kirby, Fauna Bor. Amer., vol. 4, 1837, p. 260. *Genotype.—Cryptocentrum lineolatum* Kirby.

Pararhyssa WALSH, Trans. St. Louis Acad. Sci., vol. 3, 1873, p. 109. *Genotype.—Rhyssa persuasoria* (Linnaeus.)

As originally described the genus *Rhyssa* included all of the Palaearctic Rhyssini but since the time of Holmgren European authors have restricted the genus much as it is in the present paper. American authors have not, however, been as careful and, with the exception of Viereck and Merrill, have included species now placed in *Rhysella* in the genus *Rhyssa*. While Holmgren was the first to point out the clypeal character which separates the genus *Rhyssa* from its allies Merrill was the first to point out the decided difference in the first sternite.

Although there is a superficial resemblance between *Rhyssa* and *Rhyssella*, the genus *Rhyssa* is remarkably distinct from the other genera of this tribe. As far as has definitely been proven the species are parasitic on horntail larvae belonging to the subfamily Siricinae, all of which live in coniferous trees. There are some records of *Rhyssa* being parasitic on the larvae of the Cerambycid genus *Monohammus* but considering the habits of the *Monohammus* larva it seems that these records are open to question. There are other records of *Rhyssa* being parasitic on the Coleopterous genus *Serropalpus* but none of these have been definitely proven and should be verified before accepted.

Generic characters.—Clypeus with a medium projection; nervulus postfurcal; areolet normally present; propodeum with two raised median, longitudinal ridges; the propodeal spiracle fully three times as long as wide and about twice its length from the base of the pro-

podeum; spiracles of the first tergite close to the base, the distance between them greater than the distance from one of them to the anterior margin of the segment; first sternite completely separated from the tergite; second sternite with the median tubercles at about the middle; tergites not at all emarginate posteriorly; abdomen of the male slightly widening posteriorly, about three times as long as the head and thorax; second tergite with distinct lunulae.

Merrill[1] considers that the markings of the black species are subject to such variation that they cannot be used to separate species and he would consider all of the American forms (except *hoferi*) as one species. It does not seem to the writer that this is correct. The form with the black posterior orbits (*alaskensis*) is constant for the specimens examined and it has a more restricted distribution. The form with the annulated antenna (*lineolata*) while it has much the same distribution as *persuasoria*, is confined to the Nearctic region and without more evidence it seems unwise to consider that a species would have a black antenna in one region and that in another it would have a black or a white-annulated antenna. The writer prefers to recognize, in the black forms, three species and would separate the species by the following color characters:

TABLE TO THE SPECIES.

1. General color ferruginous; stigma yellow; wings pale brownish with a darker cloud along radius..*hoferi* Rohwer.
   General color black; stigma black; wings uniformly hyaline or subhyaline.. 2.
2. Posterior orbits black, immaculate, antennae black...........*alaskensis* Ashmead.
   Posterior orbits marked with yellow.. 3.
3. Antennae black..*persuasoria* (Linnaeus).
   Antennae with a pale annulus..................................*lineolata* (Kirby).

RHYSSA ALASKENSIS Ashmead.

Rhyssa alaskensis Ashmead, Proc. Wash. Acad. Sci., vol. 4, 1902, p. 199.
Rhyssa skinneri Viereck, Trans. Amer. Ent. Soc., vol. 29, 1903, p. 87.

Type of *alaskensis* Cat. No. 5620, U.S.N.M.; type of *skinneri* Acad. Nat. Sci. Philadelphia. Discussion based on types and specimens listed below.

The type of *alaskensis* Ashmead differs from the type of *skinneri* Viereck in having the middle area of the face smooth and practically without sculpture (in the type of *skinneri* the middle area of the face has irregular dorsad-ventrad raised lines); in having a yellow spot on the propodeum; and in having an entirely black mesepisternum. Specimens from Hoquiam, Washington, collected at the same time on a spruce log infested with horntail larvae show that the sculpture of the face is variable and that the spots on the propodeum and mesepisternum vary. The specimens examined show the following variation: Length, 18–30 mm. Coxae usually black but in a

[1] Trans. Amer. Ent. Soc., vol. 41, 1915, p. 142.

few specimens rufo-piceous; mesepisternum black or with a large yellow spot posteriorly; propodeum black or with a large yellow spot or two smaller ones.

Distribution.—Fox Point, Alaska (type locality); Hoquiam, Washington from Sitka spruce (H. E. Burke); Moscow, Idaho (C. V. Piper); Meyers, California (F. B. Herbert) a form with rufo-piceous hind coxae; Beulah, New Mexico (type-locality of *skinneri*).

RHYSSA PERSUASORIA (Linnaeus).

Ichneumon persuasorius LINNAEUS, Syst. nat., ed. 10ª I, 1858, p. 562.

Location of type unknown. Discussion based on the specimens listed below which have been compared with many European specimens received from specialists.

The size of the yellow markings especially those of the mesepisternum, propodeum and abdomen varies somewhat. In a male and female from Falls Church, Virginia, the pale marks on the tergites and narrow and almost form bands. The color of the legs is fairly constant but in some specimens the hind pair (especially the coxae) are piceous or blackish.

Distribution.—Canada; Oswego County, New York; Washington, District of Columbia; Falls Church, Virginia (Middleton); Pisgah Ridge, North Carolina (Fiske); Texas (Belfrage); Whitefish Point, Michigan (A. W. Andrews); El Paso County, Colorado (A. B. Champlain); Waldo Canon, Colorado (W. D. Edmonston); Williams Canon, Colorado (Hofer); Fort Garland, Colorado (A. D. Hopkins); Scofield, Utah (C. L. D. Bliss); Fieldbrook, California (H. S. Barber).

Hosts.—Parasitic on *Xeris* sp. in *Abies concolor* (Champlain), *Sirex* sp. in *Pinus virginiana* (Middleton), and reared from fir in connection with *Serropalpus* (Fiske). Records from the files of the Branch of Forest Insects, Bureau of Entomology.

RHYSSA LINEOLATA (Kirby).

Cryptocentrum lineolatum KIRBY, W. Kirby, Fauna Bor. Amer., vol. 4, 1837, p. 260.

Rhyssa albomaculata CRESSON, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 318.

Epirhyssa crevieri PROVANCHER, Fauna Can. Hym., 1881, p. 449.

Megarhyssa nitida MERRILL not Cresson, Trans. Amer. Ent. Soc., vol. 41, 1905, p. 137. (Merrill does not tell how many specimens he saw or where they came from, but one male which he returned to the United States National Museum labeled as *Megarhyssa nitida* is certainly *lineolata*.)

The type of *lineolata* is in the British Museum, and it has not been studied by the writer. Type of *albomaculata*, Cat. No. 1438, Acad. Nat. Sci. Philadelphia. Type of *crevieri*, yellow label 388, second Provancher collection, Public Museum, Quebec. Discussion based on the types of *albomaculata* and *crevieri* and the specimens listed below.

The width of the annulus of the antennae varies somewhat, but it never gradually fades out; it is broader in the females than in the

males. The size of the yellow spots varies somewhat. The legs are usually rufoferruginous, but occasionally the hind legs, especially the coxae, are blackish. In one female from Colorado the hind legs are black with a pale spot on the coxae and tibiae and tarsi brownish beneath.

Distribution.—Canada; Cap Rouge, Canada (type-locality of *crevieri*); New Jersey (type-locality of *albomaculata*); Erie County, New York (Blackman); Detriot, Michigan; Great Falls, Virginia (Banks); Morgantown, West Virginia (Hopkins); Colorado National Forest; Hoquiam, Washington (Burke); Vancouver, British Columbia.

Host.—Parasitic on *Xeris* sp. in spruce, from observations made by H. E. Burke and on file in the Branch of Forest Insects, Bureau of Entomology.

RHYSSA HOFERI, new species.

The color of this species is unusual for members of this genus, and because of this *hoferi* has a superficial resemblance to small species of the genus *Megarhyssa* and to *Labena*. In structure this species is certainly *Rhyssa*. The color, as well as the sculpture of the pronotum and tergites, readily distinguishes it from other Nearctic species.

Female.—Length to end of abdomen, about 16 mm.; length of ovipositor beyond abdomen, 20 mm. Head, with the exception of the obscurely transversely wrinkled face, smooth; vertex with very fine aciculation and in postocellar area with scattered punctures; ocelli rather large, the postocellar line slightly shorter than the ocellocular line; antennae slightly thickening apically, the third joint distinctly longer than the fourth; sides of the pronotum dorsally with separate, fairly distinct punctures on a granular surface; anterior coxae truncate anteriorly; prepectal carina present only ventrally; mesepisternum mostly coriaceous; propodeum coriaceous; tergites opaque, finely punctato-coriaceous; tubercles on the second sternite elongate, areolet distinct, triangular, the second recurrent a little more than its width basad of second intercubitus. Ferruginous; inner orbits, spot on clypeus, posterior orbits narrowly, narrow dorsal margin and lower anterior margin laterally of pronotum, spot beneath tegulae and anterior tibiae basally, yellowish; sutures of the thorax and base of second, third, and fourth tergites narrowly brownish or blackish; antennae uniformly ferruginous; wings infumate, with the area along the radius and occupying most of the cubital area dusky; venation brownish, stigma yellowish.

Type locality.—Garden of the Gods, Colorado. Described from two females (one type) caught, June 23, 1915, while ovipositing in dying tree of *Pinus edulis* infested with Buprestidae. Material collected by George Hofer, for whom the species is named.

Type.—Cat. No. 22133, U.S.N.M.

Genus EPIRHYSSA Cresson.

Epirhyssa CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 39. *Genotype.*—*Epirhyssa speciosa* Cresson.[1]

According to various authors (Ashmead, Morley) the genus *Rhyssonota* Kriechbaumer is a synonym of *Epirhyssa* Cresson, but as this group is not well represented in the collections of the United States National Museum and as it is outside the area covered by this paper, no discussion, other than to present a few notes on Cresson's types, will be given at this time. The genus *Epirhyssa* has not been understood by American authors and the following notes are presented in order that Cresson's species may be placed in the present classification. None of the Nearctic species assigned to *Epirhyssa* belong there.

Generic characters.—Clypeus truncate; frons unarmed; nervulus interstitial; areolet wanting; propodeum not areolated; first sternite fused with the first tergite basally; spiracles of the first tergite at about the basal third, the distance between them less than the distance from one of them to the anterior margin of the segment; second sternite of the female with two median tubercles near base; second tergite without lunulae; abdomen of the male a little more than twice as long as the head and thorax, slightly widening posteriorly; tergites three to five rather shallowly emarginate in male, hardly emarginate in female.

TABLE TO CRESSON'S SPECIES.

1. Stigma black; wings yellowish with the apical margin brown; scutum yellow except for the brownish notauli.......................................*mexicana* Cresson.
   Stigma yellow; wings subhyaline with the apical margin somewhat dusky; scutum mostly brown.. 2.
2. Tergites beyond the third uniformly castaneous; hind legs castaneous; recurrent postfurcal by the length of the intercubitus....................*speciosa* Cresson.
   Tergites beyond the third yellowish with the basal margins brownish; hind legs mostly yellow; recurrent postfurcal by half the length of the intercubitus. *alternata* Cresson.

RHYSSELLA, new genus.

Genotype.—*Rhyssa nitida* Cresson.

The species which are grouped together under the new generic name *Rhyssella* have been placed both in *Rhyssa* and *Megarhyssa*. They are in general habitus more like *Rhyssa* but in structural characters are closer to *Megarhyssa*. The more recent classifications have placed them in *Megarhyssa* but it seems to the writer that their habitus, habits and structural characters are of sufficient value to be considered generic.

Generic characters.—Clypeus truncate; nervulus postfurcal; areolet variable, normally present, but often petiolate or completely wanting;

[1] Morley, Rev. Ichn. Brit. Mus., pt. 2, 1913, p. 4.

propodeum with two raised, median, longitudinal ridges; the propodeal spiracle about two and one-half times as long as wide and about three times its length from the base of the propodeum; spiracles of the first tergite close to the base, the distance between them greater than the distance from one end of them to the anterior margin of the segment; first sternite fused with the tergite basally; second sternite of the female with the median tubecles near the base; second tergite with lunulae; tergites three to six not, or but slightly, emarginate posteriorly; abdomen of the male nearly parallel-sided and about three times as long as the head and thorax; ovipositor usually somewhat longer than body.

All the species which have been reared are parasitic on horntail larvae of the genus *Xiphydria.*

There are only two species which occur in the Nearctic fauna and these are easily distinguished by color characters. One of our species is very close to a common European species and the European species is included in the following key for that reason. The notes on the European species are based on specimens in the United States National Museum which were determined by Konow.

TABLE TO THE SPECIES.

1. Posterior orbits broadly yellow; mesepisternum and sternum and sides of the propodeum reddish-yellow, tergites with lateral yellow spots. .*humida* (Say).
   Posterior orbits black; mesothorax and propodeum black; tergites black.... 2.
2. Apices of hind femora and tibiae black; North America..........*nitida* (Cresson).
   Hind femora and tibiae concolorous; Europe..............*curvipes* (Gravenhorst).

RHYSSELLA HUMIDA (Say).

Pimpla humida Say, Bost. Journ. Nat. Hist., vol. 1, 1836, p. 224.

The type of *humida* is lost and none of the specimens studied by Walsh seem to be in existence. The following discussion is based on specimens listed below. The female from Fort Lee, New Jersey, is chosen as a neotype.

Distribution.—Indiana (Say, and a specimen determined by Merrill); Illinois (Walsh); Connecticut (Patton); Fort Lee, New Jersey (Zabriskie); Harrisburg, Pennsylvania (Champlain); Lyme, Connecticut (Champlain).

Host.—Patton records this as being parasitic on the larva of *Xiphydria attenuata* Norton and Champlain has collected it as parasitic on *Xiphydria abdominalis* Say and on *Xiphydria erythrogastra* Ashmead.

RHYSSELLA NITIDA (Cresson).

Rhyssa nitida Cresson, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 319. Male.
Rhyssa canadensis Cresson, Can. Ent., vol. 1, 1868, p. 35. Female.
Epirhyssa clavata Provancher, Addit. fauna. Can. Hym., 1886, p. 115.

The types of *nitida* Cresson and *canadensis* Cresson are both in the Academy of Natural Sciences, Philadelphia. The type of *clavata* is in

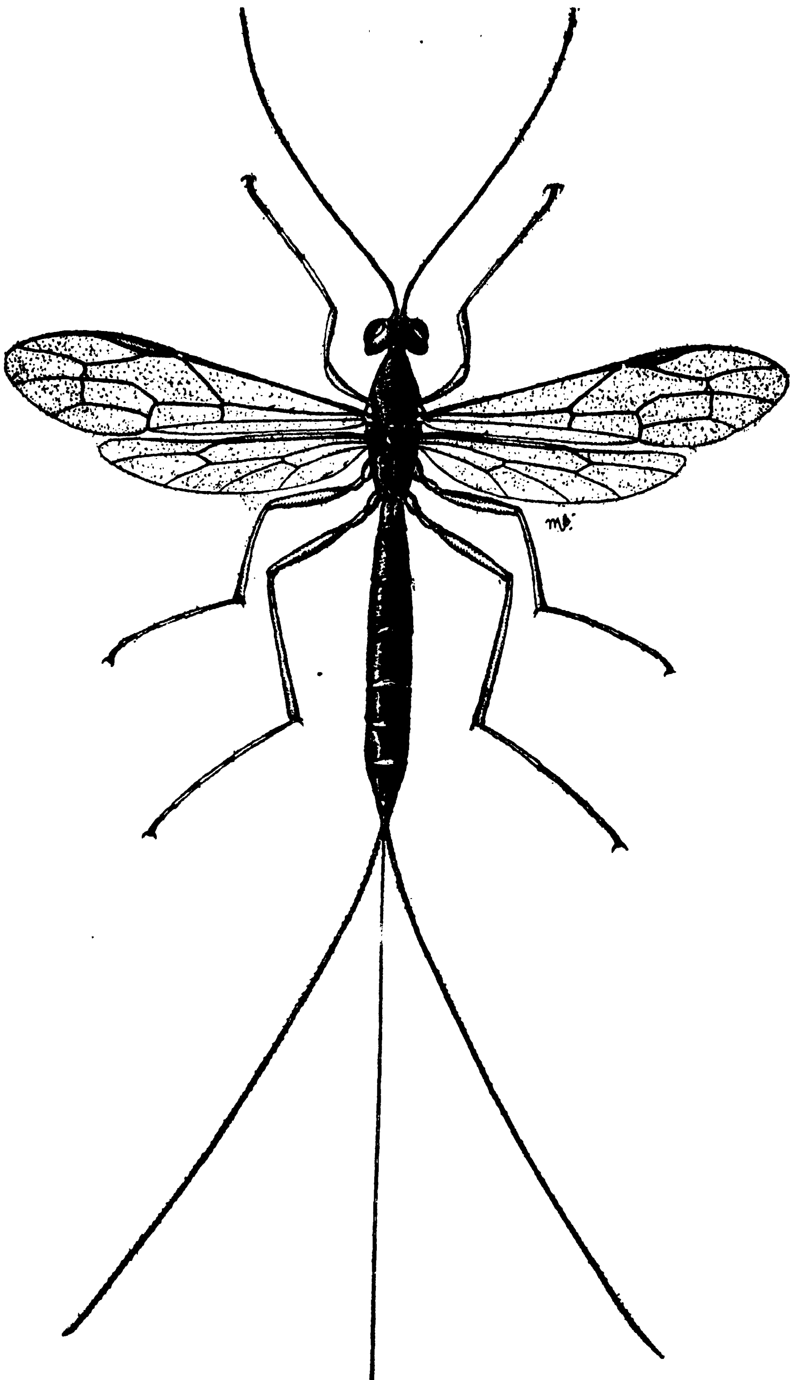

FIG. 2.—FEMALE OF RHYSSELLA NITIDA (CRESSON).

the second Provancher collection in the Public Museum of Quebec and bears yellow label 1260. Discussion based on the types, homotypes and specimens from the localities listed below.

Specimens of males and females reared from the same piece of maple limb included males which could not be distinguished from the type of *nitida* and females which could not be distinguished from the type of *canadensis*; so there can be no doubt that the above synonymy is correct. This species is very close to the European *curvipes* (Gravenhorst) and other than the unsatisfactory color characters given in the above key no differences could be found. It seems to the writer, that it is better to retain Cresson's name for the American form until there is more evidence that it is the same as the European species. Merrill's[1] conception of this species is entirely wrong, as is abundantly proven by the types and the descriptions The abdomen is black.

Distribution.—"Virginia, Dr. T. B. Wilson" (type-locality for *nitida*) "Quebec, Couper" (type locality for *canadensis*); "Cap Rouge" (type-locality for *clavata*); Pennslyvania; Clementon, New Jersey; Washington, District of Columbia (van Horn); Plummer's Island, Maryland (Barber, Middleton, Rohwer); Columbia, South Carolina (G. F. Atkins); Akron, Ohio; Detroit, Michigan.

Host.—According to rearings by van Horn, Middleton and Rohwer of the branch of Forest Insects of the Bureau of Entomology this is a common parasite of the larva of *Xiphydria maculata* Say.

Genus MEGARHYSSA Ashmead.

Thalessa Holmgren, Öfvers. Svensk. Vet. Akad. Förh., vol. 16, 1859, p. 122 (preoccupied by Adams in 1853). *Genotype.*—(*Ichneumon*) *Megarhyssa superbus* (Schrank). Through synonymy.

Megarhyssa Ashmead, Can. Ent., vol. 32, 1900, p. 368.

This generic group was first recognized by Holmgren, but unfortunately in naming it he chose a name which had already been used, so it was necessary to rename it and this was done by Ashmead in 1900. Neither Schmiedeknecht nor Morley have thought it necessary to use Ashmead's name, although they may have been misled by the way Dalla Torre gives the references.

The Nearctic species of this genus are easily recognized by the size, long ovipositor, and color. The Oriental species are apparently not as easily recognized by superficial characters, as there seems to be some confusion about the genus *Lytarmes* Cameron, which has never been satisfactorily characterized.

All of the species which have been reared are parasitic on the larvae of horntails and all but one of them seem to confine their attacks to species of the genus *Tremex*.

[1] Trans. Amer. Ent. Soc., vol. 41, 1915, p. 137.

Generic characters.—Clypeus truncate; nervulus postfurcal; areolet present; propodeum with two raised, median longitudinal ridges; propodeal spiracle three or more times as long as wide and about twice its length from the base of propodeum; spiracles of the first tergite close to the base, the distance between them greater than the distance from one of them to the base of the segment; first sternite fused with the tergite at the base; second sternite with the median tubercles of the female near the base; second tergite with lunulae; tergites 3 to 6 deeply angulately emarginate posteriorly; abdomen of the male parallel-sided and more than three times as long as the head and thorax; ovipositor as long as or much longer than the body.

The four recognized Nearctic species are easily distinguished by the following key which is based mostly on color.

TABLE TO THE SPECIES.

1. Middle of the posterior margin of the heavily chitinized basal part of the first sternite extending in female distinctly beyond a line drawn tangent to the posterior margin of the first tergal spiracle, in male extending beyond such a line by a distance as great as that from the anterior margin of the first tergal spiracle to the base of tergite; ovipositor not more than one and one-half times as long as body; wings of male hyaline, of female hyaline with a cloud below stigma.
greenei Viereck.

   Middle of the posterior margin of the heavily chitinized basal part of the first sternite in female distinctly before and in male beyond this point about the length of the line drawn tangent to the posterior margin of the first tergal spiracle; spiracle of ovipositor nearly twice, often thrice, as long as the body.... 2.

2. Wings subhyaline with a large cloud below stigma; lateral marks on the tergites V-shaped; ovipositor about twice as long as body; anterior femora one-third longer than their tibiae.. *lunator* (Fabricius).

   Wings unicolorous.. 3.

3. Stigma yellowish; wings subhyaline; mesonotum and mesepisternum in the male black; yellow of front of the head in the male restricted to orbital lines; female with yellowish spots on the sides of the tergites; ovipositor about twice as long as the body.. *nortoni* (Cresson).

   Stigma black; wings of male subhyaline, of female blackish; mesonotum and mesepisternum of male marked with pale; face of male mostly yellow; thorax and abdomen of female black; ovipositor distinctly more than twice as long as the body.
atrata (Fabricius).

MEGARHYSSA GREENEI Viereck.

Megarhyssa greenei VIERECK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 191, female, not male.

Type.—Cat. No. 13499, U.S.N.M. Discussion based on types and specimens from localities listed below.

The male which Viereck assigned to this species is in the writer's opinion a small male of *lunator* (Fabricius). Rearings and the structural characters of the first sternite show that the wings of the male of *greenei* are without a cloud below the stigma.

Distribution.—Harrisburg, Pennsylvania (type-locality, and material collected by Fisher); Linglestown, Pennsylvania (Fisher), Cory,

Pennsylvania (Walton); Indiana; Sherbrook, Canada; Tryon, North Carolina (Fiske).

Host.—*Tremex columba* (Linnaeus) in hickory from rearings made by W. S. Fisher, of Branch of Forest Insects, Bureau of Entomology.

MEGARHYSSA LUNATOR (Fabricius).

Ichneumon lunator FABRICIUS, Spec. Insect., vol. 1, 1781, p. 430.

Megarhyssa greenei VIERECK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 191, male, not female.

The type of this well-known species seems to be lost, but inasmuch as it is impossible to say definitely it is inadvisable to fix a neotype. Discussion based on specimens from the localities mentioned below.

Distribution.—This species is common in the Eastern States and it probably occurs as far west as the Rocky Mountains. Specimens from the following localities are in the collection: New York; New Jersey; Philadelphia, Cory, Harrisburg, Linglestown, Pennsylvania; Washington, District of Columbia; Falls Church, Virginia; Pendleton, South Carolina; Jacksonville, New Philadelphia, Illinois; Wyandotte, Michigan; Boulder, Colorado (A. J. Evans).

Host.—Parasitic on the larvae of *Tremex columba* (Linnaeus) according to Riley and many rearings by the Branch of Forest Insects, Bureau of Entomology.

MEGARHYSSA NORTONI (Cresson).

Rhyssa nortoni CRESSON, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 317.

Thalessa quebecensis PROVANCHER, Nat. Can., vol. 5, 1873, p. 447.

Thalessa superba (Schrank) MORLEY, Rev. Ichn. Brit. Mus., pt. 2, 1913, p. 16. (North American specimens.)

The type of *nortoni* is in the Academy of Natural Sciences, Philadelphia. The type of *quebecensis* is probably lost. Discussion based on type of *nortoni* and specimens from localities listed below.

Morley considers this species to be a synonym of the European *superba* (Schrank) but if the European specimens of *superba* which are in the United States National Museum are correctly determined (and they agree with the descriptions) then the two can easily be separated by the first sternite, as follows:

Middle of posterior margin of the heavily chitinized basal part of the first sternite in female much before and in male even with a line drawn tangent to the posterior margin of the first tergal spiracle; mesonotum of male black......*nortoni* (Cresson).

Middle of posterior margin of the heavily chitinized basal part of the first sternite in female and male much beyond a line drawn tangent to the posterior margin of the spiracle; mesonotum of male largely pale................*superba* (Schrank).

Distribution.—Provancher records this from Canada. Specimens in the United States Museum are from the following localities: El Paso County, Colorado (A. B. Champlain); Kansas; Panguitch (H. E. Burke), Scofield (C. S. D. Bliss), Utah; Easton (Koebele), Olympia (C. V. Piper), Mount Rainier (C. V. Piper), Hoquiam (H. E. Burke),

Washington; Meyers Vade (F. B. Herbert), Yosemite (J. J. Sullivan), California; Tanana, Alaska (K. W. Strangman); Pisgah Mountain, North Carolina, altitude 5,600 feet (A. D. Hopkins).

Host.—A. B. Champlain of the Branch of Forest Insects has reared this species from the larva of a species of *Xeris* living in *Abies concolor*.

MEGARHYSSA ATRATA (Fabricius).

Ichneumon atratus FABRICIUS, Spec. Insect, vol. 1, 1781, p. 436.
Ichneumon tenebrator THUNBERG, Bull. acad. sci. St. Peters., vol. 8, 1822, p. 266.
Rhyssa laevigata BRULLÉ, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 78, pl. 40, fig. 2.

Types of none of these species have been seen. Discussion based on specimens from the localities listed below.

Distribution.—Billerica, Massachusetts (T. F. Lyon); Long Island, New York; Cory (W. R. Walton), Harrisburg (W. S. Fisher), Guys Mills (Heinrich), Pennsylvania; Washington, District of Columbia; Great Falls, Virginia (R. P. Currie); Cabin John, Plummer's Island (H. S. Barber) Maryland; Chattanooga, Tennessee; East Florida (Ashmead); Bellevue, Indiana; Georgia (J. H. Bryan); Clinton, Arkansas.

Although this species is common there seems to be no positive record of its having been associated with its host.

UNRECOGNIZED SPECIES.

THALESSA? HISTRIO Kreichbaumer.

Thalessa? histrio KREICHBAUMER, Ann. naturhist. Hofmus. Wien., vol. 5, 1890, p. 487.

It is certain that this species does not belong to the genus *Megarhyssa* and although Moscary places it in the genus *Epirhyssa* the writer is of the opinion that when the type is examined it will be found to belong to some other tribe.

Tribe XORINDINI Cushman and Rohwer.

Xoridini CUSHMAN and ROHWER, Proc. U.S.Nat.Mus., vol. 57, 1920, p. 395.

As here defined the tribe Xoridini contains only those genera which have the mandibles edentate apically so it is only a part of the tribe Xoridini of other authors.

In certain characters the Xoridini are allied to the Rhyssini, while in others they are allied to the Odontomerini. The apically edentate mandibles will, however, easily distinguish this tribe from all others of the subfamily.

As far as known, all of the species are parasitic on the larvae of insects living in wood.

Tribal characters.—Head subquadrate, not swollen below the antennae, posterior orbits broad; mandibles edentate apically and usually without an inner tooth, occasionally (*Poemenia*) with a

short inner tooth; clypeus transverse, apically depressed so there is a more or less distinct mouth opening, or convex and without a mouth opening (*Poemenia*); thorax depressed; mesepisternum longer than high; prescutum long, usually completely defined; wings placed much behind the middle of thorax; propodeum shorter than the scutum; legs usually simple, always simple in male, but in some females (genus *Xorides*) the tibiae are constricted; claws simple; wings usually without an areolet; abdomen longer than head and thorax; ovipositor long, cylindrical.

The three genera belonging to this tribe may be easily recognized by the following table:

TABLE TO THE GENERA.

1. Eyes parallel or nearly; malar space long; propodeum areolated..*Xorides* Latreille.
   Eyes strongly converging toward the clypeus; malar space very narrow; propodeum not areolated.. 2.
2. Mandibles without an inner tooth; apical part of clypeus depressed so there is a distinct mouth opening; posterior orbits with a raised ridge which is covered with transverse rugosities; areolet wanting; apical tergite of female long, somewhat trowel-shaped....................................*Deuteroxorides* Viereck.
   Mandibles with an inner tooth; clypeus not depressed apically; posterior orbits without a raised ridge; areolet often present; apical tergite of female short. *Poemenia* Holmgren.

Genus XORIDES Latreille.

Xorides LATREILLE, Gen. Crust. Ins., vol. 4, 1809. p. 4. *Genotype.*—(*Ichneumon*) *Xorides indicatorius* (Latreille).

Xylonomus GRAVENHORST, Ich.Eur., vol. 3, 1829, p. 819. *Genotype.*—*Ichneumon irrigator* Fabricius.

Gonophonus FOERSTER, Verh. naturh. Ver. preuss. Rheinland, vol. 25, 1868, p. 169. *Genotype.*—*Gonophonus mokrzechii* Koknjev.

Moerophora FOERSTER, Verh. naturh, Ver. preuss. Rheinland, vol. 25, 1868, p. 169. *Genotype.*—*Xylonomus rufipes* Gravenhorst.

Rhadina FOERSTER, Verh. naturh. Ver. preuss. Rheinland, vol. 25, 1868, p. 170 (not Waterhouse)=*Rhadinopimpla* Schulz.

Rhadinopimpla SCHULZ, Zool. Ann., vol. 4, 1909 (1911), p. 23, new name for *Rhadina* Foerster, not Waterhouse. *Genotype.*—*Xylonomus ater* Gravenhorst.

Sichelia FOERSTER, Verh. naturh. Ver. preuss, Rheinland, vol. 25, 1868, p. 169. *Genotype.*—*Xylonomus filiformis* Gravenhorst.

Sterotrichus FOERSTER, Verh. naturh. Ver. preuss, Rheinland, vol. 25, 1868, p. 169. *Genotype.*—*Xylonomus pilicornis* Gravenhorst.

The genotype of the genus *Xorides* Latreille is a species which up to the present time has not been recognized by European writers and it was impossible for the writer to determine to which group, of the long recognized genus *Xylonomus*, it belonged. Inasmuch as it was very desirable to know something about the species the assistance of that careful European authority of Ichneumonoidea, Dr. A. Roman, was sought and under date of February 14, 1916, he replied as follows:

"I have the pleasure to inform you that the *Xorides indicatorius* Latr. was fortunately easy to find out. It is, without any doubt, the same species as *Xylonomus ferrugatus* Grav. Ichn. Fur. 3, p. 840,

belonging to *Xylonomus* in its strictest sense." From this is to be seen that the long recognized name *Xylonomus* will have to be placed as a synonym of *Xorides* and the group which Gravenhorst considered as *Xorides* will have to be known as *Deuteroxorides* Viereck.

Cresson[1] was the first American author to recognize this group as occurring in the Western Hemisphere. Later [2] he listed and tabulated the American species. Since then the group has been recognized correctly by all American writers under the name *Xylonomus* and the species were again tabulated by Harrington [3] when he described *canadensis*. Later Davis described two species (*catomus* and *maudae*) and in 1913[4] Rohwer described seven species and endeavored to use as subgenera certain of the genera erected by Foerster.

The shape, length and carination of the first tergite of the female offers very valuable specific characters yet there is such a gradation from a short medianly constricted and dorsally carinate to a long gradually widening noncarinate segment that no tangible grouping can be made on this character alone. Again there is such antigeny in the length and sculpture of the tergites that this character cannot be used in grouping the species. Foerster would restrict *Xylonomus* to those forms in which the first tergite is constricted medianly, but this restriction can not be used with any reliance without first removing difficult species. Rohwer[5] proposed to separate *Moerophora* from *Xylonomus* s. s. by the relative length of the second tergite as compared with its apical width—a character used by Foerster to separate *Sichelia* from *Rhadina*—but this character, although useful, can not be strictly applied and is available only in the female. The secondary sexual character used by Foerster to separate *Sterotrichus* can not be considered of generic value; nor is the position of the nervulus, as compared with the basal, as employed by Foerster to separate off *Gonophonus*, a sufficiently stable character to be used generically. If this last-mentioned character were used it would be necessary to erect new "genera" and it would widely separate species which are otherwise rather closely allied. Or, to express it briefly, the writer does not believe that any of Foerster's segregates of *Xylonomus* when defined only on the characters he uses can be considered as natural groups sufficiently distinct to be treated as genera. They seem to be a hasty expression of characters which may distinguish the various species groups found in Europe. Our American species fall into a number of natural groups, some of which are probably the same as the European groups, while others are different from the European groups and if we were to name all of them we would need a number of new names. The genotypes

[1] Proc. Ent. Soc. Phila., vol. 4, 1865, p. 288.

[2] Trans. Amer. Ent. Soc., 1870, p. 167 and p. 172.

[3] } " Ent., vol. 23, 1891, p. 134.

[4] Proc. U. S. Nat. Mus., vol. 45, pp. 353-358.

[5] Idem, vol. 45, 1913, p. 353.

of all of the genera proposed by Foerster are not in the United States National Museum collection but notes on those examined are given to show the way these generic names would apply to the American species:

Gonophonus.—Genotype not available but it is evident that this group is not represented in America by any described species.

Moerophora.—Genotype not available but group probably represented in America by *humeralis* or *stigmapterus*.

Sichelia.—Apparently not represented in America but no European specimens are available.

Sterotrichus.—A single male of the genotype, determined by Schmiedeknecht, shows that this belongs close to group *frigidus* but has the striate orbits of group *maudae* and would run there in the key. It is probably the same group as *Xorides* (= *Xylonomus*) in the strict sense.

Rhadinopimpla.—Genotype not available but a male determined by Roman as *R. brachylabris* Kriechbaumer belongs to group *insularis* and differs from the male of that group in the presence of a median carina on the first tergite.

Xorides (= *Xylonomus*).—Genotype of *Xylonomus*, as determined by Roman, would fall more properly in group *frigidus* but has striate orbits of group *maudae*.

In grouping the American species the sculpture of the orbits and vertex has been found to be very useful character and is used a number of times as the primary character because it is the same for both sexes while the useful characters of the abdomen apply only to the female.

As far as known, all the species of this genus are parasitic on the larvae of wood-inhabiting insects and mostly on Coleoptera of the families Cerambycidae and Buprestidae.

Generic characters.—Inner margin of eyes parallel or nearly; malar space long; malar furrow present; facial quadrangle variable; antennae long, slender and in the female sometimes banded with white; nervulus antifurcal, interstitial or postfurcal; nervellus perpendicular or reclivous, broken near the middle; legs not swollen or twisted but the tibiae are often constricted at the base; propodeum truncate posteriorly, more or less completely areolated, the spiracle elongate, well removed from base; abdomen longer than head and thorax, subpetiolate to subsessile, depressed, the base of second tergite with more or less distinct, depressed areas laterally; ovipositor cylindrical, usually as long as or longer than the body.

TABLE TO THE SPECIES.

1. Posterior orbits with strong antroposterior striae; prescutum with a median depression.......... 2.
   Posterior orbits with oblique striae or smooth; prescutum without a median depression.......... 6.

2. Basal area triangular, separated from areola by a longitudinal carina; no carina from spiracle of first tergite to apex of segment; first three tergites with large punctures; lateral dorsal angles of pronotum strongly tuberculate; vertex anteriorly shining, practically without sculpture; third tergite of male without basal lateral triangular area..........................(group **humeralis**).... 3.
   Basal area and areola confluent; a distinct carina from spiracle of first tergite to apex of segment; first three tergites smooth or aciculate; lateral dorsal angles of pronotum not especially prominent; vertex sculptured; third tergite with a triangular-shaped lateral area at base ....(group **maudae**).... 5.
3. Wings uniformly brownish; body rufopiceous..................*piceatus* (Rohwer).
   Wings hyaline or with brownish marks; body black..................... 4.
4. Wings with a brownish band below stigma..................*australis* (Cresson).
   Wings uniformly subhyaline...................................*humeralis* (Say).
5. Female antennae with small annulus; first tergite black; male with abdomen entirely red...*neoclyti* (Rohwer).
   Female antennae black; first tergite rufous; abdomen in male black or with first two tergites reddish..*maudae* (Davis).
6. First tergite short distinctly constricted medianly; orbits impunctate; black species....................................(group **frigidus**).... 7.
   First tergite not constricted medianly.................................. 8.
7. First tergite of female with two dorsal carinae from constriction to apex of tergite; male not known....................................*frigidus* (Cresson).
   First tergite of female without median dorsal carinae from constriction to apex; see description of male...............................*yukonensis* (Rohwer).
8. First tergite with prominent median carinae which may extend to apex of segment; posterior orbits always with a white spot .... 9.
   First tergite without median carinae or if present in males the color does not agree; posterior orbits without a white spot................................ 11.
9. Facial quadrangle longer than broad; face almost impunctate; scutum polished, sparsely punctured; base of third tergite in male with a depressed area laterally; abdomen black with white marks................(group **albopictus**).... 10.
   Facial quadrangle broader than long; face with distinct punctures; scutum opaque with close poorly defined punctures; third tergite in male without a depressed area; abdomen unicolorous...........(group **calidus**)....*calidus* (Provancher).
10. Basal area triangular and separated from areola by a carina..*albopictus* (Cresson).
    Basal area and areola confluent...........................*duplicatus* (Rohwer).
11. Posterior orbits smooth or with a few punctures below....(group **rileyi**).... 12.
    Posterior orbits obliquely striate.. 13.
12. Tibiae black; hind coxae rufous..........................*ruficoxis* (Rohwer).
    Tibiae with a white annulus at base; hind coxae usually black but occasionally rufous..*rileyi* (Ashmead).
13. Vertex smooth, with only a few scattered punctures; antennae of female black. (group **insularis**).... 14.
    Vertex closely punctured or punctato-striate; antennae of female with an annulus. (group **stigmapterus**).... 15.
14. Posterior dorsal margin of pronotum yellow; second and third tergites transversely aciculate; scutum shining, sparsely punctured.............*insularis* (Cresson).
    Pronotum black; second and third tergites granular; mesonotum punctate to striato-punctate...*eastoni* (Rohwer).
15. Females.. 16.
    Males (only four species are known in this sex).......................... 21.
16. Heavily chitinized part of first sternite medially terminating distinctly before a line drawn tangent to the posterior margin of the spiracle of first tergite; carinae dividing meta-pleura and -sternum terminating much before hind coxal fossae; abdomen broader.. 17.

Heavily chitinized part of first sternite terminating beyond or at a line drawn tangent to the posterior margin of spiracle of the first tergite; carinae dividing meta-pleura and -sternum complete to the fossae of hind coxae; abdomen narrower.. 18.

17. Black; second and third tergites coarsely coriaceous; apical joint of hind tarsi black.. *harringtoni* Rohwer.

At least the head with ferruginous marks; second and third tergites finely transversely aciculate; apical joint of hind tarsi concolorous with preceding. *catomus* (Davis).

18. Four posterior tibiae unicolorous; lateral dorsal angles of propodeum tuberculate, but the tubercle is not as long as basal width.......................... 19.

Four posterior tibiae with white annulus at base; lateral dorsal angles of propodeum with a long tubercle or spine which is at least twice as long as basal width.. 20.

19. Ferruginous; apical joint of hind tarsus concolorous with the preceding; wings strongly brownish.................................... *californicus* (Cresson).

Black; apical joint of hind tarsus black, the preceding white; wings nearly hyaline. *cincticornis* (Cresson).

20. Ferruginous; apical joint of hind tarsus concolorous with the preceding. *floridanus* (Ashmead).

Black; apical joint of hind tarsus black, the preceding joint white. *stigmapterus* (Say).

21. Tibia unicolorous.. 22.

Tibiae with pale annulus at base.................................... 23.

22. Apical joint of hind tarsus black, the preceding whitish; body and legs black. *cincticornis* (Cresson).

Apical joint of hind tarsus concolorous with the preceding; ferruginous, especially the head, legs and abdomen.............................. *californicus* (Cresson).

23. Lateral dorsal angles of propodeum with a short tubercle..... *harringtoni* Rohwer.

Lateral dorsal angles of propodeum with a prominent tooth.... *stigmapterus* (Say).

Group HUMERALIS.

Group characters.—Elongate species. Facial quadrangle longer than wide; posterior orbits with antro-posterior striae; frons with large close punctures; vertex almost without sculpture (except at occiput); antennae of male clothed with long hair; lateral dorsal angles of pronotum strongly tuberculate; prescutum with a distinct median longitudinal depression; propodeum with coarse punctures, basal area triangular and separated from the areola by a longitudinal carina; first tergite not constricted medianly, about three times as long as apical width, without carinae; the chitinized part of the sternite ending well before a line drawn tangent to the posterior margin of the spiracle in the female and somewhat beyond in the male; second tergite distinctly longer than its apical width; base of third tergite of male without a triangular-shaped area laterally; the first three tergites with large close punctures. Black or dark piceous, without white markings; four anterior legs usually paler than the posterior ones; posterior tibia with a whitish annulus at base; antenna of male black, of female with a white annulus.

The three species of this group are very closely allied and it may be that with more material so much variation will be found that the color characters used in distingishing them will prove unreliable.

XORIDES AUSTRALIS (Cresson).

Xylonomus australis CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 167.

Type.—No. 1520.1, Acad. Nat. Sci. Phila. Notes from type, paratype and specimen listed below.

Louisiana, Texas (Cresson); Hondo, Texas, "on *Cassia*" June 3, 1909, (J. D. Mitchell).

XORIDES PICEATUS (Rohwer).

Xylonomus stigmapterus SAY, Howard, Insect Book, 1904, pl 9, fig. 2.
Xylonomus (*Macrophora*) *piceatus* ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 357.

Type.—Cat. No. 15370, U.S.N.M. Type is only specimen known. Dade County, Florida (Schwarz).

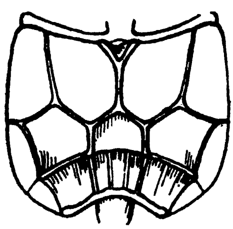
FIG. 3.—PROPODEUM OF XORIDES PICEATUS (ROHWER).

XORIDES HUMERALIS (Say).

Anomalon humerale SAY, Contr. Maclur. Lyc. Phila., vol. 2, 1828, p. 74.
Xorides humeralis (Say) SAY, Boston Journ. Nat. Hist., vol. 1, pt. 3, 1836, p. 223.
Xylonomus lavalensis PROVANCHER, Nat. Canad., vol. 6, 1874, p. 59.
Xylonomus humeralis (Say) PROVANCHER, Nat. Canad., vol. 12, 1880, p. 100.

Type.—Say's type is lost and Provancher's type is a female labeled as *humeralis* with yellow label 517 in the 1877 Provancher collection in the Public Museum, Quebec. Neotype of *humeralis* is in the Academy of Natural Sciences, Philadelphia, determined by Cresson. Notes from neotype of *humeralis*, type of *lavalensis*, and specimens listed below.

Indiana (Say); Quebec (Provancher); Ontario (Harrington); Ithaca, New York (Banks); Falls Church, Virginia (Banks); Mount Graybeard, North Carolina (Banks); Texas (Belfrage); Plummer's Island, Maryland (Hopkins); Wayland, Massachusetts (Craighead).

Host.—*Phymatodes varius* and a Cerambycid in box elder. From rearings by Branch of Forest Insects, Bureau of Entomology.

Group MAUDAE.

Group characters.—Rather stout species. Facial quadrangle somewhat longer than wide; frons transversely wrinkled; vertex with separate punctures; posterior orbits transversely striate; antennae of the male without long hair; angles of the pronotum not especially prominent; prescutum depressed in the middle; scutum and prescutum wrinkled medianly, punctured laterally; propodeum rather short, its surface punctured or coriaceous, not prominently angulate; the basal

area and areola confluent; first tergite in female short, its length not twice its apical width, not constricted medianly; with strong carina from spiracle to apex of segment in both sexes; the first three tergites finely wrinkled or granular; base of third tergite in male with a triangular area laterally. Black or dark piceous with some white markings on head and thorax; legs black or black and red; abdomen black, red and black, or entirely red; antenna of male black, of female black or with a faint white annulus.

XORIDES MAUDAE (Davis).

Xylonomus maudae Davis, Trans. Amer. Ent. Soc., vol. 22, 1895, p. 32.

Type.—In the Academy of Natural Sciences, Philadelphia. Notes from type and specimens listed below.

Washington (Davis); both sexes from Corvallis, Oregon; female from Menlo Park, California, June, 1905 (F. Hornung).

XORIDES NEOCLYTI (Rohwer).

Moerophora neoclyti Rohwer, Proc. U. S. Nat. Mus., vol. 49, 1915, p. 223.

Type.—Cat. No. 18421, U.S.N.M. Notes from unique male type and female described below.

Female.—Length of body 14.5 mm.; length of ovipositor 7.5 mm. Postocellar line nearly twice as long as ocellocular line; third antennal joint slightly shorter than fourth, fourth and fifth subequal; side of pronotum wrinkled anteriorly, punctured posteriorly; mesepisternum shining with irregular punctures medianly, irregularly wrinkled anteriorly and posteriorly; first three tergites finely wrinkled. Black; abdomen dark piceous; inner orbits to a line drawn tangent to anterior ocellus, thirteenth and fourteenth antennal joints and a small spot at base of all tibiae whitish; tarsi piceous. Wings hyaline, a spot around nervulus, one along first abcissa of radius connecting with one around intercubitus dusky; venation black.

Described from one female from Arizona.

The male is from Santa Catalina Mountains, Arizona.

Host.—*Neoclytus capraea* Say.

Group FRIGIDUS.

Group characters.—Facial quadrangle much wider than long; face finely wrinkled; frons shining, punctured or finely wrinkled; vertex and posterior orbits shining, with at most a few scattered punctures; postocellar line longer than the ocellocular line; antennae of male hairy; pronotum angulate but not dentate; prescutum shining not depressed in middle; scutum laterally shining, medially it and prescutum are somewhat wrinkled; propodeum coriaceous, without prominent teeth; costulae present; basal area and areola confluent; nervellus perpendicular or slightly reclivous, broken a little above the middle; first segment rather short, constricted medially, and some-

times with dorsal carinae, without a complete carina from spiracle to apex of segment although it is present apically; second tergite of female with apical width greater than length, in male about one and one-half times as long as apical width; tergites granular or somewhat reticulate, opaque; ovipositor longer than abdomen. Black; legs more or less rufous; antennae black in both sexes; wings hyaline.

XORIDES FRIGIDUS (Cresson).

Xylonomus frigidus CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 168.
Xylonomus (*Xylonomus*) *plesius* ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 354.

Type of frigidus.—Cat. No. 1522, Acad. Nat. Sci. Phil. *Type of plesius*: Cat. No. 15365, U.S.N.M. Notes from types.

In describing *plesius* it was compared with a specimen determined as *frigidus* by Ashmead and Viereck, but an examination of the type of *frigidus* showed that this determination was wrong and that *plesius* is really a synonym of *frigidus*.

The male of this species is unknown and when it is found it will probably prove to be very closely allied to *yukonensis*.

Hudson Bay Territory; United States.

XORIDES YUKOENSIS (Rohwer).

Xylonomus (*Moerophora*) *yukonensis* ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 355.

Type.—Cat. No. 15367, U.S.N.M. Notes from type and from specimens listed below.

This species is closely allied to *frigidus* (Cresson) and the character made use of in the table is about the only one.

Male.—Length 11 mm. Antennae as long as body; very like the female but the sculpture is stronger; propodeal carinae strong, the median ones nearly confluent so the basal area at first sight seems separated from the areola; first tergite with strong complete median carinae. Black; tegulae, four anterior legs and posterior coxae and trochanters rufous.

A specimen from Sherbrook is slightly larger and has the frons punctato-striate while in the type the frons is punctured.

Fort Yukon, Alaska; Sherbrook, Canada; Boulder, Colorado (Cockerell).

Group ALBOPICTUS.

Group characters.—Facial quadrangle longer than wide, shining almost impunctate; posterior orbits smooth above, obliquely striate below; postocellar line distinctly longer than ocellocular line; antennae of male with short hair; angles of pronotum prominent but hardly toothed; scutum and prescutum shining, sparsely punctured; propodeum sparsely punctured, carinae strong, lateral angles not prominently toothed; basal area and areola confluent, or separated

by a longitudinal carina due to the coalescing of the median carinae; first tergite in female a little more than twice as long as apical width, with complete median carinae in both sexes; second tergite in female distinctly wider than long; base of third tergite of male with a triangular depressed area laterally; tergites coriaceous or (in female) with the third and fourth transversely aciculate; nervulus slightly postfurcal; nervellus slightly reclivous, broken at the middle; ovipositor as long as or shorter than the abdomen. Black, with

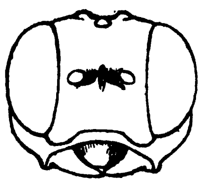

FIG. 4.—FRONT VIEW OF HEAD OF XORIDES ALBOPICTUS (CRESSON.)

FIG. 5.—PROPODEUM AND BASAL ABDOMINAL SEGMENTS OF XORIDES ALBOPICTUS (CRESSON).

yellow markings; posterior orbit with yellow spot; antenna of female with an annulus; wings hyaline.

XORIDES ALBOPICTUS (Cresson).

Xylonomus albopictus CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 168.
Xorides canadensis PROVANCHER, Nat. Can., vol. 7, 1875, p. 248.

Type of albopictus.—Cat. No. 1518, Acad. Nat. Sci. Phila. The type of *canadensis* is lost unless it is one of the specimens under name *Xylonomus albopictus*, it is probable that Provancher recognized that *canadensis* was synonymous with *albopictus* as he omits it from from the "Fauna." Synonymy made by study of description and because of Harrington's statement.[1]

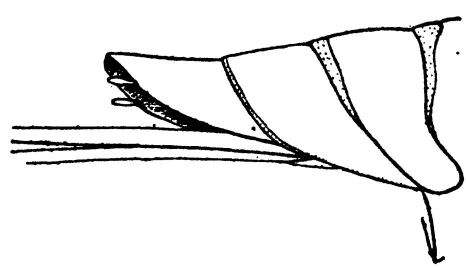

FIG. 6.—APICAL ABDOMINAL SEGMENTS OF XORIDES ALBOPICTUS (CRESSON.)

This is the commonest American species and is easily recognized by its markings and the characters used in the table. The yellow line on the dorsal lateral part of the pronotum is another character by which to separate it from its ally, *calidus*.

Canada; New York (Cresson); Harrisburg (and vicinity) (Fisher, Kirk, Champlain), Philadelphia (G. M. Greene); Pennsylvania; West Virginia (Hopkins); Tryon, North Carolina (Fiske); Deweyville, Texas (Fiske); Indiana; Chicago, Illinois (Kahl); Michigan.

[1] Can. Ent., 1893, p. 133.

Host.—According to many rearings by Branch of Forest Insects Bureau of Entomology, this is a common parasite of *Saperda discoidea* in hickory and probably occurs throughout the range of its host.

XORIDES DUPLICATUS (Rohwer).

Xylonomus (*Moerophora*) *duplicatus* ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 356.

Type.—Cat. No. 15369, U.S.N.M.

This is known only from a unique male and is probably nothing more than a specimen of *albopictus* with abnormal aerolation of the propodeum, but inasmuch as none of the many specimens of *albopictus* show any such variation it is probably best to retain the name for the time being.

Clark Station (near St. Louis), Missouri.

Group CALIDUS.

Group characters.—Facial quadrangle broader than long, with distinct close punctures; posterior orbits shining above, obliquely striate below; postocellar line distinctly longer than the ocellocular line; antennae of male with short hair; angles of pronotum not prominent; scutum and prescutum opaque, with close poorly defined punctures; propodeum rather closely punctured, carinae strong, angles not prominently dentate; basal area and areola confluent; first tergite of female about twice as long as apical width, with distinct median carinae which are complete in the male but end before apex of segment in female; second tergite of female wider than long; base of third tergite of male without depressed areas laterally; tergites coriaceous or granular; nervulus slightly postfurcal; nervellus perpendicular broken at middle; ovipositor shorter than abdomen. Black; head and thorax with yellow markings; posterior orbits with a yellow spot; abdomen reddish in female black in male without markings antenna of female with an annulus, of male black; wings hyaline.

XORIDES CALIDUS (Provancher).

Xylonomus calidus PROVANCHER, Addit. faun. Can. Hym., 1886, p. 119. — HARRINGTON, Can. Ent., vol. 23, 1891, p. 134.

Xylonomus pulcher ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1889, p. 450. — HARRINGTON, Can. Ent., vol. 23, 1891, p. 134.

Aplomerus nasonii DAVIS, Trans. Amer. Ent. Soc., vol. 22, 1895, p. 32.

Type of calidus.—One female with blue label with large figures 596 and name label, in second Provancher collection Public Museum, Quebec.

Type of pulcher.—Cat. No. 2120, U.S.N.M.

Type of nasonii.—Academy of Natural Science, Philadelphia. Notes from types and specimens listed below.

Harrington [1] suggests that *pulcher* Ashmead is only a variety of *calidus* Provancher and an examination of the types failed to show any differences except in the color of the mesepisternum and this character varies from black to rufous, so it is impossible to separate the two. In females the scutellum may have a yellow spot or be black, and in one specimen from Texas the abdomen is almost entirely piceous. Davis' type differs in no way from the male of *calidus*.

Male.—Length 8 mm. Face below with a few wrinkles, Black; line on clypeus, inner orbits (interrupted medially), scape beneath, spot on posterior orbits yellow; legs rufopiceous, apices of hind femora, hind tibiae and tarsi, except white bases of tibae and basitarsi, piceous black.

Canada; Pennsylvania; Fredericktown, College Park, Jackson's, Maryland; Texas (Belfrage); Cadet, Missouri; Tryon, North Carolina (Fiske).

Hosts.—According to unpublished records in Branch of Forest Insects, Bureau of Etomology, this species is a parasite of *Chrysobothris femoratus* and *Leptostylus maculus* in chestnut and probably a parasite of *Curius dentatus* in juniper.

Group RILEYI.

Group characters.— Facial quadrangle longer than wide; face rugose; frons sparsely punctured; vertex and posterior orbits smooth, with only a few punctures; postocellar line distinctly longer than the ocellocular; antennae of male hairy; angles of pronotum prominent; mesonotum punctured, more or less rugulose medially; propodeum rather coarsely punctured, carinae not especially strong, angles toothed; median carinae more or less completely coalesced, so basal area is triangular and separated from areola by a raised line; first tergite in female about two and one-half times as long as apical width and without carinae, in male about four times as long as apical width and with complete median carinae; second tergite in female with length and apical width subequal or with the apical width slightly greater; tergites punctured to striato-punctate; base of third tergite in male without a lateral depressed area; nervulus interstitial to slightly postfurcal; nervellus perpendicular, broken at the middle. Black; legs with some white marks and sometimes the hind legs are partly rufous; wings hyaline; antenna of female with a pale annulus.

The two species recognized in this group are in habitus and structure very similar and it may be with more material it will be necessary to combine the two, or it may be desirable to divide the forms of *rileyi*.

[1] Can. Ent., vol. 23, 1891, p. 135.

XORIDES RUFICOXIS (Rohwer).

Xylonomus (*Xylonomus*) *ruficoxis* ROHWER, Proc. U. S. Nat. Mus., vol. 45 1913, p. 354.

Type.—Cat. No. 15366, U.S.N.M.

The black tibiae readily separate this species from *rileyi*. It is known only from the type material.

Apalachicola, Florida.

Host.—*Physoenemum andrea* in *Taxodium distichum*.

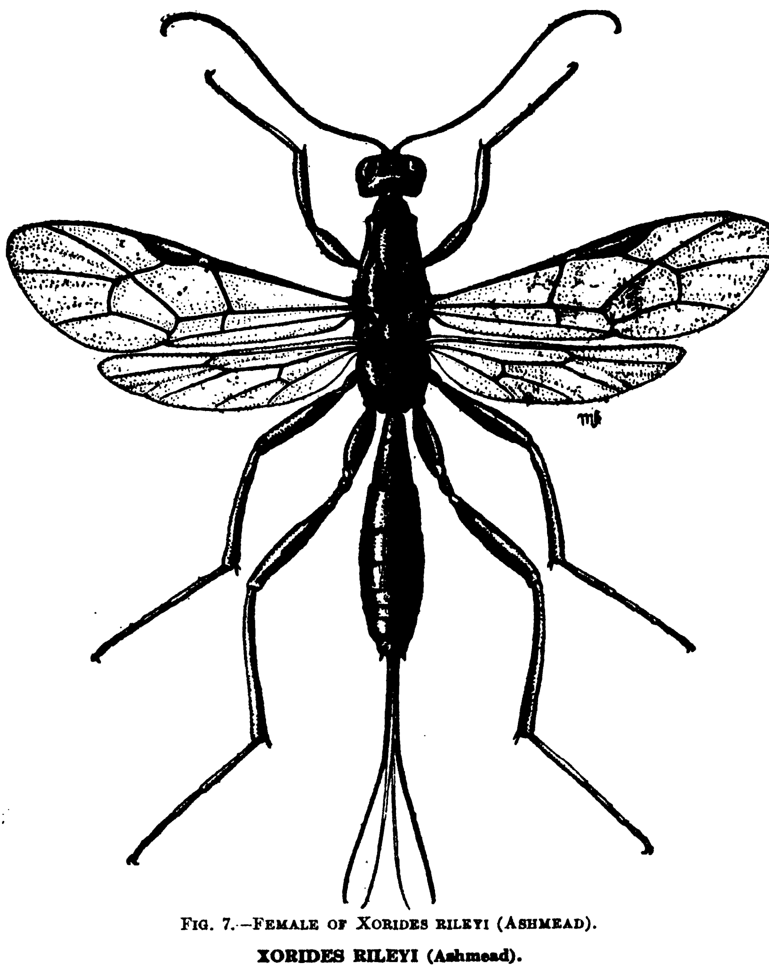

FIG. 7.—FEMALE OF XORIDES RILEYI (ASHMEAD).

XORIDES RILEYI (Ashmead).

Xylonomus rileyi ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1889, p. 450.—CHITTENDEN, Bull. 7, Div. Ent., U. S. Dept. Agric., 1897, p. 72.

Xylonomus (*Xylonomus*) *lepturae* ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 534.

Type of rileyi.—Cat. No. 2119, U.S.N.M. *Type of lepturae.*—Cat. No. 15489, U.S.N.M. Discussion based on types and specimens listed below.

There is no tangible difference between the types of *rileyi* and the types of *lepturae*, but the female specimens grouped under the name *rileyi* may be divided into three groups as follows:

1. Hind coxae rufous...*Form A.*
   Hind coxae black...2.
2. Anterior part of prescutum with widely separated punctures.............*Form B.*
   Prescutum striato-punctate or with rather close punctures anteriorly.......*Form C.*

These three forms have different hosts and future investigation may prove that they are distinct, but inasmuch as they all agree in habitus and the above characters are all that could be found it does not seem advisable to name them. The types of both *rileyi* and *lepturae* come under form B.

Missouri (Ashmead); Cherrydale (Van Horn), Veitch (Craighead, Snyder), Virginia; Washington, District of Columbia (Howard, Champlain); Linglestown, Pennsylvania (Champlain); Tryon, North Carolina (Fiske).

Host.—Chittenden records this species as a parasite of *Xylotrechus colonus.* The unpublished records of the Branch of Forest Insects, Bureau of Entomology, give the hosts as follows: *Form A* from *Xylotrechus colonus; form B* from *Leptura nitens* and *Callidium aereum;* and *form C* from *Romaleum atomarium.*

Group INSULARIS.

Group characters.—Facal quadrangle wider than long; face punctured or punctato-striate; frons sparsely punctured; vertex shining sparsely punctured; posterior orbits obliquely striate below; postocellar line subequal with the ocellocular; antennae of male with short hair, angles of pronotum not prominent; scutum sparsely punctured or punctato-striate; propodeum punctured, carinae or a carina strong but not prominent, angles not toothed; basal area triangular, separated from the areola by the short coalescing of the median carinae or the two areas confluent; first tergite in female about two and one-half times as long as basal width, without median carinae or a carina from spiracle to apex; second tergite in female slightly longer than apical width; tergites coriaceous, granular or finely transversely aciculate; base of third tergite in male without depressed areas laterally; nervulus interstitial or slightly postfurcal; nervellus perpendicular or reclivous, broken at about middle; ovipositor longer than abdomen. Black; head and sometimes thorax with some yellow markings; legs reddish, the posterior ones paler; wings hyaline; antennae black in both sexes.

XORIDES INSULARIS (Cresson).

Poemenia insularis Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 380.

Xylonomus insularis (Cresson) Cresson, Trans. Amer. Ent. Soc., 1887, p. 220.—Harrington, Can. Ent., vol. 23, 1891, p. 134.

Type.—Cat. No. 1521, Acad. Nat. Sci. Philadelphia. Notes from type, homotype and specimens listed below.

This is one of the commoner western species and varies from the typically colored form to a form with reddish propodeum and reddish spots on the mesoscutum.

Vancouver Island (Cresson); Easton (Koebele), Hoquiam (Burke), Washington; Waldo, Oregon (Sargent); Big Tree Grove, Mariposa County, California (Burke).

Host.—According to the unpublished notes of the Branch of Forest Insects, Bureau of Entomology this species is parasitic on *Hylotrupes amethystinus*, *Hylotrupes ligneus*, *Tetropium cinnamopterum*, *Tetropium velutinum*, *Melanophila drumnondi*, and *Atimia dorsalis*.

XORIDES EASTONI (Rohwer).

Xylonomus (*Moerophora*) *eastoni* ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 356.

Type.—Cat. No. 15368, U.S.N.M.

This species is known from the unique type and has a small yellow spot on the inner orbits, a character overlooked in the original description.

Fall River, Massachusetts.

Group STIGMAPTERUS.

Group characters.—Facial quadrangle wider than long, in some species markedly so while in others the width is but little greater than the length; face coarsely punctured or coriaceous; frons closely punctured; vertex closely punctured (in some species the punctures are separated by a distance somewhat greater than the diameter of an ocellus) or punctato-striate; posterior orbits with oblique striae; antennae of male nearly bare; angles of pronotum prominent but not dentate; abdomen dull or shining, closely or sparsely punctured, anteriorly and posteriorly more or less striate; propodeum coriaceous, carinae strong, angles variable; basal area and areola confluent; first tergite in female two to four times as long as apical width, without median dorsal carinae, with a more or less complete carina from spiracle to apex; second tergite in female longer than apical width, in some species (*stigmapterus*, etc.) distinctly so while in others (*catomus*) the difference between length and width is not great; base of third tergite in male without or with only incomplete depressed areas laterally; basal tergites coriaceous, granular or transversely aciculate; nervulus slightly postfurcal; nervellus perpendicular or reclivous, broken at about middle; ovipositor longer than body. Black or ferruginous; legs with white markings; wings hyaline to brownish, antenna of female with a pale annulus.

The species of this group are closely allied and in the ferruginous species this color is often partly replaced by black. As far as the material is available the species can easily be distinguished by the above table, but males of all of the species are not at hand, and it will prob-

ably be found difficult to associate males or to determine them without female representatives of all the species.

XORIDES HARRINGTONI, new name.

Xylonomus canadensis Harrington, Can. Ent., vol. 23, 1891, p. 134. [Not *Xorides canadensis* Provancher=*albopictus*.]

Type, allotype, paratypes in Harrington collection; *Paratype* male, metatype (also homotype) in United States National Museum. Paratype Cat. No. 20933, U.S.N.M. Notes on types.

In the general black color this species is like *cincticornis* and *stigmapterus*, but besides the characters used in the table *harringtoni* may be distinguished from *cincticornis* by the pale annulus at the base of the tibia, and from *stigmapterus* by the habitus being more robust.

Ottawa, Canada.

XORIDES CATOMUS (Davis).

Xylonomus catomus Davis, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 372.

Type.—Cat. No. 176, Acad. Nat. Sci. Philadelphia. Notes from types and specimens listed below.

This species varies from piceous with ferruginous marks on the head to entirely ferruginous. In the ferruginous specimens the legs are ferruginous while in the piceous specimens the hind femora and tibiae are piceous. Wings subhyaline.

Craigs Mountain, Moscow, Idaho (Davis); Missoula (Brunner), Darby (Bishopp), Montana; Albee, Oregon (Edmonston); Fallen Leaf, California (Herbert); Boulder, Colorado (Marshall).

Hosts.—Edmonston has obtained this as a parasite of *Chalcophora angulicollis* in *Pinus ponderosa* and Brunner as a parasite of *Alaus oculatus* and from material containing *Memythrus perlucida*.

XORIDES CALIFORNICUS (Cresson).

Xylonomus californicus Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 380.

Type.—Cat. No. 1523, Acad. Nat. Sci. Philadelphia. Notes from type and specimens listed below.

This species is in structure very close to *cincticornis*, but the ferruginous color will separate it from that species. The color varies from ferruginous to almost piceous, but in the piceous specimens the head is mostly ferruginous and it is also easy to distinguish the piceous color from the deep black of *cincticornis*. The male differs from *cincticornis* in the same manner as does the female.

California (Cresson); Mendocino County (Coquilett), Summerdale (Burke), Fallen Leaf, and Placerville (Herbert), California.

Host.—Herbert has collected this at Placerville, California, as a parasite of *Buprestis laeviventris* in *Pinus ponderosa*.

XORIDES CINCTICORNIS (Cresson).

Xylonomus cincticornis CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 288.
Xylonomus (*Moerophora*) *modestus* ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 358.

Type of cincticornis.—Cat. No. 1519, Acad. Nat. Sci. Phila.; *type of modestus*—Cat. No. 15371, U.S.N.M. Notes on types and specimens listed below.

Very like *californicus*, but it is to be distinguished by color characters. From the other black species of this group the unicolorous tibiae will make it easy to recognize this species.

Colorado (Cresson); El Paso County, Colorado (Champlain); Corvallis, Oregon; Skokomish River, Washington.

Host.—Champlain has obtained this as a parasite of a species (probably *chrysocoma*) of *Leptura* in *Pinus scopulorum*.

XORIDES FLORIDANUS (Ashmead).

Xylonomus floridanus ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1889, p. 451.

Type.—Cat. No. 2121, U.S.N.M.

This species is known only from the type.

Archer, Florida. Collected by E. A. Schwarz.

XORIDES STIGMAPTERUS (Say).

Acoenitus stigmapterus SAY, Keating's Narr. Exp., vol. 2, 1824, App., p. 325; LeConte's Edit. Say, vol. 1, p. 218.
Xylonomus stigmapterus (Say) CRESSON, Trans. Amer. Ent. Soc., 1870, p. 167.—WALSH, Trans. St. Louis Acad., vol. 3, 1873, p. 165.—HARRINGTON, Can. Ent., vol. 23, 1891, p. 134.

Say's type is lost and the specimen in the Academy of Natural Science in Philadelphia bearing the name label and determined by Cresson should be considered as a neotype for this species. Notes from neotype and the specimens listed below.

The above table will separate this species from its allies, while the accounts listed in the bibliography will make its identity certain.

United States and Canada (Cresson). Specimens from the following localities are in the collection: New York; Linglestown, Pennsylvania (W. S. Fisher); Sherbrook, Canada; Rock Creek Park, District of Columbia; Rosslyn (Shannon), Falls Church (Middleton), Virginia.

Host.—W. S. Fisher has reared this as a parasite of *Leptura proxima* in hickory.

Genus DEUTEROXORIDES Viereck.

Deuteroxorides VIERECK, Bull. 83, U. S. Nat. Mus., 1914, p. 43. *Genotype.*—*Xorides albitarsus* Gravenhorst.
Xorides GRAVENHORST and AUTHORS (not Latreille).

When Gravenhorst in 1829 divided the genus *Xorides* Latreille he made no mention of the species on which Latreille founded his genus,

but restricted *Xorides* to species which he considered to be congeneric with *albitarsus* Gravenhorst. This restriction, which excludes the genotype, has unfortunately been adopted by all writers except Viereck (1914) who calls attention to the nomenclatorial error and proposes the name *Deuteroxorides* to replace *Xorides* Gravenhorst and Authors.

Deuteroxorides is one of the most easily recognized genera in the subfamily Ichneumoninae, and although it has many characters in common with *Xorides* can easily be distinguished by the characters mentioned in the generic table. Its species are parasitic on such wood-boring insects as Cerambycids, Buprestids, and Siricids, yet in one instance it has been recorded as reared from a Lepidopterous insect, *Laspeyresia toreuta*, living within the cones of pines.

Eyes strongly converging below; malar space very narrow; malar furrow wanting; posterior orbits with a raised ridge which is armed with tubercules; prescutum well defined anteriorly, not tuberculate; disk of the mesonotum transversely aciculate or striate; propodeum long, gently sloping, not areolate or at most the petiolar area present; legs long, normal; abdomen long, compressed apically in the female, parallel sided in the male; apical tergite of female much produced; nervellus reclivous, broken well above the middle.

No reliable structural characters to separate the species have been discovered and it was necessary to resort to color. The color of the abdomen, head markings and mesoscutum are subject to considerable variation, while the markings of the pronotum and mesepisternum are constant and offer good specific characters. The relative length of the ovipositor is subject to such wide variation (as is proven by reared specimens of *caryae*) that it can not be used as a specific character.

TABLE TO THE SPECIES.

1. Mesepisternum beneath with oblique yellow band............*caryae* (Harrington).
Mesepisternum without an oblique yellow band, black or with small yellow spots below the tegula.. 2.
2. Upper posterior margin of the pronotum with a yellow line (in the female the lower margin is black, in the male yellow).......................*vittifrons* (Cresson).
Upper posterior margin of the pronotum black, the lower margin yellow. *borealis* (Cresson).

DEUTEROXORIDES CARYAE (Harrington).

Xorides caryae Harrington, Can. Ent., vol. 23, 1891, p. 132.

Type.—Collection of Harrington, lacks antennae. Notes from specimen compared with type and specimens from localities listed below.

This species is easily recognized by the yellow line on the mesepisternum. In the extent of the yellow markings of the abdomen, thorax above and head it is subject to but little variation, but the reddish markings of the legs vary from bright red to reddish piceous.

There is considerable variation in size of the body (from 9 to 20 mm.), while the length of the ovipositor varies but little (6 to 8 mm. beyond the tip of the abdomen). In the type the body is 9.5 mm. long and the ovipositor extends 8 mm. beyond the end of the abdomen; yet in other specimens the body is 20 mm. long and the ovipositor extends 8 mm. beyond the end of the abdomen.

Ottawa, Canada (Harrington); Detroit, Michigan (Hopkins); Harrisburg (and vicinity) (Fisher and Kirk), Overbrook (Geo. M. Greene)

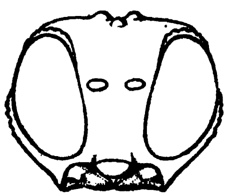

FIG. 8.—FRONT VIEW OF HEAD OF DEUTEROXORIDES CARYAE (HARRINGTON).

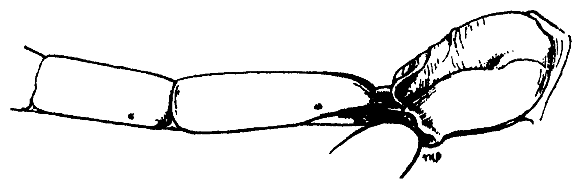

FIG. 9.—PROPODEUM AND BASAL ABDOMINAL SEGMENTS OF DEUTEROXORIDES CARYAE (HARRINGTON).

Pennsylvania; Ballston, Virginia (Snyder); Pink Beds, North Carolina (Fiske).

Host.—Saperda discoidea. Harrington[1] records as a probable host of species *Dorchaschema nigrum*, but numerous rearings from the Branch of Forest Insects, Bureau of Entomology, indicate that *Saperda discoidea* is the only host.

DEUTEROXORIDES VITTIFRONS (Cresson).

Xorides vittifrons CRESSON, Can. Ent., vol. 1, 1868, p. 37.

Type.—Acad. Nat. Sci. Phila. No. 1514. Notes from homotype and specimens from localities listed below.

Harrington[1] would separate this species off by its relatively longer ovipositor but this character is extremely variable and can not be relied upon. The color characters offered in the above table are the only characters which have given satisfaction.

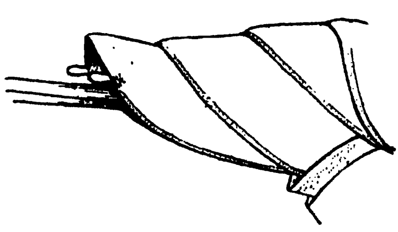

FIG. 10.—APICAL ABDOMINAL SEGMENTS OF DEUTEROXORIDES CARYAE (HARRINGTON).

London (Cresson), Ottawa (Harrington), Canada; New York; Overbrook, Pennsylvania (Geo. M. Greene); Tryon, North Carolina (Fiske).

Hosts: Harrington records this species "upon old maples infested with *Dicerca divaricata, Xiphydria albifrons, Tremex columba,* etc." and Dalla Torre records the insects in the "old maples" as hosts of *vittifrons.* The only authentic host record available is *Graphisurus fasciatus* based on rearings of the Branch of Forest Insects, Bureau of Entomology.

[1] Can. Ent., vol. 23, 1891, p. 133.

DEUTEROXORIDES BOREALIS (Cresson).

Xorides borealis CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 167, female.
Xorides occidentalis CRESSON, Proc. Acad. Nat. Sci. Phila., 1878, p. 380, male.

Type.—Acad. Nat. Sci. Phila. (*borealis*) No 1516; (*occidentalis*) No. 1515. Notes from specimens compared with types, and other material from the localities listed below.

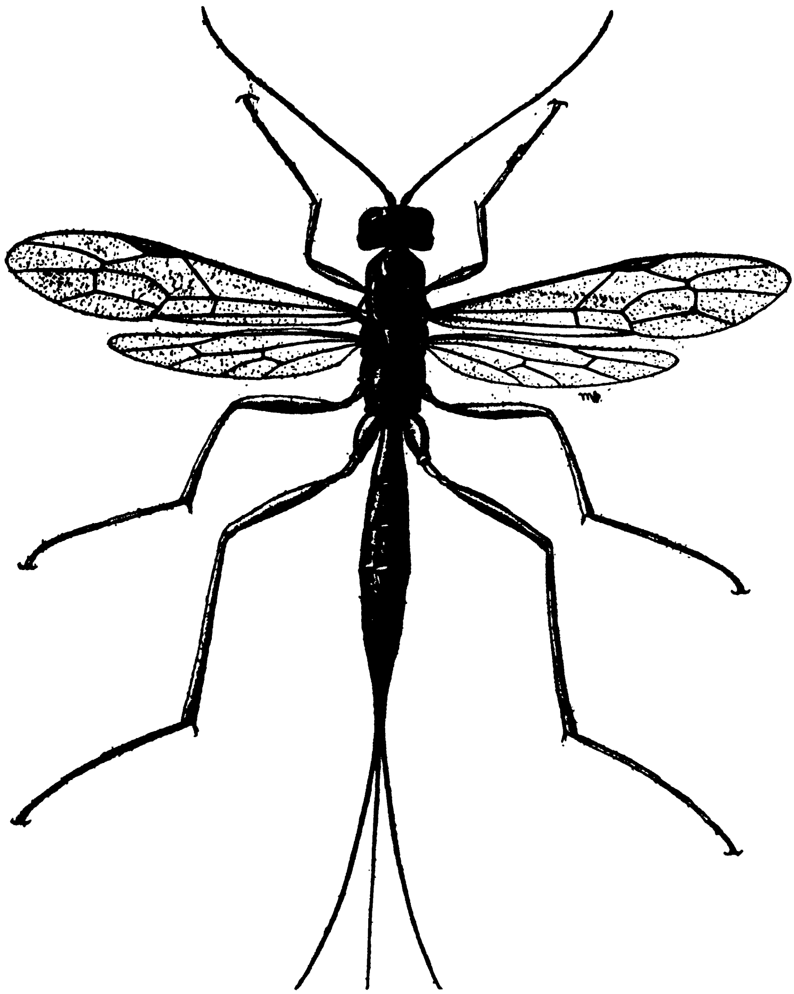

FIG. 11.—FEMALE OF DEUTEROXORIDES CARYAE (HARRINGTON).

Harrington[1] separated *occidentalis* Cresson from *borealis* Cresson (and all other species) by the absence of white markings on the apical margins of the tergites. This character is subject to great variation, and as no other characters have been found to separate these forms it seems necessary to place them under one name. The

[1] Can. Ent., vol. 23, 1891. p. 133.

species varies in size from 10 to 20 mm. and from having the posterior femora black (type of *borealis*) to rufous (type of *occidentalis* and most of the other specimens). In some few specimens the sides of the propodeum and the metathorax are rufous but in most of them they are black.

Hudson Bay (Cresson), Vancouver Island (Cresson), Ottawa (Harrington), Canada; Douglas County (Hofer), Waldo Canon (W. D. Edmonston), Colorado; Mariposa County (Burke), Kyrburg (Miller), California; Hoquiam, Washington (Hopkins); Columbia Falls, Montana (Brunner); Palisades, New Jersey (Love); Tyron, North Carolina (Fiske).

Hosts.—*Atimia dorsalis; Hylotrupes ligneus; Tetropium velutinum,* Unknown Cerambycid in chestnut; a Buprestid in Douglas Fir; and an unverified record of *Laspeyresia toreuta* Grote. Records from rearings of Branch of Forest Insects, Bureau of Entomology.

Genus POEMENIA Holmgren.

Poemenia Holmgren, Öfvers. Vet.-Akad. Förh., vol. 16, 1859, p. 130. *Genotype.*—*Poemenia notata* Holmgren.

Calliclisis Foerster, Verh. naturh. Ver. preuss. Rheinland, vol. 25, 1868, p. 169.—Schmiedeknecht, Zool. Jahrb., vol. 3, 1888, p. 440. *Genotype.*—*Ephialtes hecticus* Gravenhorst.

Euxorides Cresson, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 167. *Genotype.*—*Euxorides americanus* Cresson.

The genus *Poemenia* was first recognized by Holmgren for a species which he described under the name *notata*. A few years later Foerster, recognizing Holmgren's genus, separated off certain other species (none mentioned by name) as the genus *Calliclisis* because they lacked the areolet. Two years after Foerster's work was published Cresson placed one American species in a new genus, *Euxorides*, which he considered closely allied to *Deuteroxorides* but distinguished from it by the presence of an areolet. Although the type of *Poemenia* is not available there seems, to the author, no reason to consider that it is different from the other two genera. The only difference which has been offered is the absence of the areolet and this is not even a specific character as in some specimens it is present in one wing and completely wanting in the other. The suppression of *Calliclisis* is further supported by the fact that Dr. A. Roman has given the United States National Museum specimens of the genotype of *Calliclisis* labeled as *Poemenia* (*Calliclisis*). The presence of an inner tooth on the mandibles, the nondepressed clypeus and the short last tergite in the female makes *Poemenia* a somewhat discordant element in the tribe Xoridini, but in general appearance, and in most of the characters of the head, thorax and abdomen, it so closely resembles *Deuteroxorides* that it is certain that it belongs near it. The characters used in the above key, however, show how easily they may be distinguished.

The species whose biology is known are parasitic on insects living within wood or woody substance.

Head subquadrate; eyes large, reaching to near the base of mandibles, strongly converging below; mandibles rather broad, with an inner tooth which is shorter than the outer; malar furrow wanting; clypeus not depressed; posterior orbits broad and without a ridge; antennae not annulated, long and slender; notauli well defined anteriorly but poorly defined posteriorly; prepectus almost wanting; propodeum long, sloping, the spiracle nearly round and placed at about the middle; legs normal, long and slender; areolet present or wanting, when present petiolate and with the outer vein usually incomplete; nervellus reclivous, broken above the middle; abdomen long and slender; hypopygidium and last tergite short; ovipositor of variable length.

The species of *Poemenia* resemble each other very closely and are separated largely by unisexual characters and color. There are but few specimens in any collection and when more material has been studied it may be that an entirely different arrangement will be desirable. The following key is almost a copy of a synopsis made from the Philadelphia types by R. A. Cushman and is based on the females.

TABLE TO THE SPECIES.

1. Ovipositor nearly as long as the body; meso- and meta- pleura marked with red (usually) .... 2.
   Ovipositor much shorter than the body; pleura black .... 3.
2. Mesoscutum and scutellum red; spiracles of the first tergite prominent. *thoracica* (Cresson).
   Mesoscutum black; scutellum red; spiracles of the first tergite not prominent. *vancouverensis* (Provancher).
3. Ovipositor nearly as long as the abdomen; tergites narrow, the first hardly one-third as wide as long, the second nearly twice as long as wide..... *albipes* (Cresson).
   Ovipositor but little more than one-half the length of the abdomen; first tergite but little more than twice as long as wide, second one-third longer than wide. *americana* (Cresson).

POEMENIA THORACICA (Cresson).

Ephialtes thoracicus CRESSON, Proc. Acad. Sci. St. Louis, 1878, p. 377.

Type.—Cat. No. 1539, Acad. Nat. Sci. Philadelphia.

This species which is known only from the type material is very close to *vancouverensis* (Provancher) and the latter may only be a color form. The following notes were made from the type by R. A. Cushman:

Female.—"Length 12 mm., ovipositor 10.5 mm. Black, with clypeus, mandibles (except at base and tip), palpi, scape and pedicel beneath, mesonotum, scutellum, meso- and meta-pleura red; tegulae, line in front and antero-ventral margin of pronotum yellowish; front and middle legs yellowish, middle tarsi fuscous; hind legs some-

what darker, their trochanters above infuscated and tibiae and tarsi black.

"Eyes converging toward the clypeus, face clypeus and mandibles clothed with dense yellowish pubescence, longer on clypeus and mandibles; antennae (broken) with flagellar joints 1–4 subequal in length, those beyond decreasing gradually in length; pronotum laterally smooth and shining, minutely aciculate posteriorly and dorsally; rest of thorax clothed with very short, dense, appressed, yellowish pubescence, minutely punctate, stronger on metapleura and propodeum, the latter with a median furrow and slightly angulate laterally; wings hyaline with yellow stain, veins, brown, whitish at base; abdomen minutely granularly punctured, and with dense, minute pubescence; first tergite a little more than three times as long as wide, its spiracles prominent."

Vancouver's Island.

POEMENIA VANCOUVERENSIS (Provancher).

Euxorides vancouverensis PROVANCHER, Addit. faun. Can. Hym., 1883, p. 369.
Ephialtes vancouverensis HARRINGTON, Can. Ent., vol. 26, 1894, p. 249.

Type of Provancher's species is in the second Provancher collection at the Public Museum of Quebec and bears yellow label 1556. The type of Harrington's species in the Harrington collection. Both types examined.

This species has the heavily chitinized part of the first sternite terminating at about the middle, and in some of the specimens examined has the thorax almost entirely black. It is probably only a dark form of *thoracicus* Cresson and has been fairly well characterized by its two describers.

Vancouver's Island (type-locality); West Cliff (T. D. A. Cockerell), El Paso County (A. B. Champlain), Colorado; Departure Bay, British Columbia (E. M. Walker).

Host.—*Leptura* species in *Pinus ponderosa* (A. B. Champlain).

POEMENIA ALBIPES (Cresson).

Ephialtes albipes CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 143.

Type.—Cat. No. 1538, Acad. Nat. Sci. Philadelphia.

The following is R. A. Cushman's redescription of the female type:

Female.—"Length 9 mm., ovipositor 3.5 mm. Black, with tegulae, scape, pedicel and first flagellar joint beneath, anteroventral margin of pronotum, palpi, four anterior legs (except middle tarsi, which are blackish) yellowish white; hind legs testaceous, their trochanters infuscated above, and their tibiae and tarsi black except narrow pale areas basally; mandible and apex of clypeus red; eyes converging toward the clypeus; face, clypeus, and mandibles clothed with dense, golden pubescence; pronotum smooth laterally, minutely aciculate posteriorly and dorsally; rest of thorax finely, granularly punctured

(somewhat coarser on metapleura and propodeum) and clothed with dense, minute pubescense; wings hyaline, irridescent; propodeum with median furrow and slightly angulate laterally; abdomen very slender the first tergite more than three times as long as wide, its spiracles subprominent; abdomen granularly punctured and finely pubescent."

Heavily chitinized part of first sternite fully two-thirds as long as the first tergite.

Canada; New Jersey (Cresson); Great Falls, Virginia; Oswego, New York; and a specimen which is probably the same species from Collins, Idaho (C. V. Piper).

POEMENIA AMERICANA (Cresson).

Euxorides americana Cresson, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 167.

Type.—Cat. No. 1517, Acad. Nat. Sci. Philadelphia. Notes taken from type and specimens listed below.

The short ovipositor makes this species easily recognized. The heavily chitinized part of the first sternite about half as long as the first tergite.

Texas; Connecticut; Pennsylvania (Cresson); Morgantown, West Virginia (A. D. Hopkins); Colorado (Baker); Del Norte, California (P. D. Sergent); Ashland, Oregon (J. M. Miller).

Host.—*Paratimia conicola* and *Laspeyresia toreuta.* This last record may be an error and *Paratimia* have been the host. From rearing by Branch of Forest Insects, Bureau of Entomology.

Tribe ODONTOMERINI Cushman and Rohwer.

Odontomerini Cushman and Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 396.

The two genera belonging to the tribe Odontomerini have heretofore been assigned to the tribe Xoridini, and although they are undoubtedly allied to this group through *Xorides*, they can easily be distinguished from it by the apically bidentate mandibles. The Odontomerini not only show affinity to the Xoridini, but they have considerable in common with the Acoenitini and are allied to this group through *Arotes*.

The hosts of the Odontomerini, as far as known, are the larvae of wood-boring Coleoptera, most of which belong to the families Cerambycidae and Buprestidae. Although many of the species are well represented in the National Collection, it seems likely that we have only a meager knowledge of the group as it really exists and that further collecting and rearing will bring to light undescribed species, and will materially increase our knowledge of the habits of the species.

Tribal characters.—Head cubical, swollen below the antennae eyes small and placed well forward; posterior orbits wider than or subequal with the diameter of the eye; head not narrowed behind;

malar furrow obsolete; malar space long; clypeus transverse; thorax depressed; prescutum completely defined; the propodeum long and truncate apically, in lateral view rectangular in outline, the spiracle elongate, slightly basad of middle; areolet wanting; legs very stout; abdomen more or less compressed apically; hypopygidium not prominent; ovipositor long, well exserted.

Some authors have considered that the areolation of the propodeum was a generic character, but examination of the species of *Aplomerus* and *Odontomerus* shows that the carinae which define the middle area may become obliterated, and the author does not consider that this character should be used for generic purposes. The two genera here recognized are readily separated by the following table.

TABLE TO THE GENERA.

1. First tergite sub-petiolate, the spiracle far removed from the base; hind femur armed with a tooth beneath........................ *Odontomerus* Gravenhorst.
   First tergite subsessile, the spiracle very close to the base; hind femur not dentate. *Aplomerus* Provancher.

Genus APLOMERUS Provancher.

Platysoma PROVANCHER, Can. Ent., vol. 17, 1885, p. 115 (not Latreille).
Aplomerus PROVANCHER, Addit. faun. Can. Hym., 1886, p. 119.
Anodontomerus ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, 1900, p. 61. *Genotype.—Platysoma tibialis* Provancher. (For all names.)

Ashmead, under the assumption that *Aplomera* Macquart preoccupied *Aplomerus* Provancher, proposed the name *Anodontomerus* for Provancher's genus. Inasmuch as the spelling is different and the International Commission on Zoological Nomenclature permits the retention of names when the spelling is as different as the two cited above, the name *Aplomerus* is used instead of Ashmead's substitute.

The genus *Aplomerus* is closely related to *Odontomerus* and agrees with it in habitus, but may be readily separated by the characters given in the above table.

From its affinities and structure the species are no doubt all parasitic on wood-boring Coleoptera.

Generic characters.—Antennae almost as long as the body; greatest width of the posterior orbits greater than or subequal with the length of the eye; clypeus narrow, limited above by the weak supraclypeal suture, not depressed apically; thorax depressed; propodeum longer than the scutum, truncate posteriorly, the lateral dorsal angles prominent but not toothed, completely or nearly completely areolated or with the two median carinae obliterated; hind coxae rather short; femora swollen, not toothed; tibiae incrassate, the middle pair twisted; claws simple; venation about as in *Odontomerus;* abdomen subsessile; the first tergite without prominent carinae, its spiracles

placed close to the base, that is, about one-fourth the length of the tergite; ovipositor usually as long as the body.

For the only species known the sculpture of the head, thorax, and abdomen offer the specific characters.

TABLE TO THE SPECIES.

This table is based on females only.

1. Median carinae of propodeum obliterated; base of second tergite sparsely punctured.. *buprestivorus* Rohwer.
   Median carinae of propodeum well developed; base of second tergite striate.....2.
2. Vertex and posterior orbits with large, distinct, separate punctures; second tergite with fine striae which cover about one-fifth of the segment, the rest of the tergite polished; third and following tergites without sculpture; ovipositor longer than the body.................................... *tibialis* (Provancher).
   Vertex and posterior orbits practically impunctate; second tergite nearly completely striate; third and fourth tergites finely transversely aciculate; ovipositor as long as the body.................................... *foutsi* Rohwer.

APLOMERUS BUPRESTIVORUS, new species.

This species differs from the others assigned to the genus in having the median carinae of the propodeum obliterated and in this character does not agree with the genus as defined by Ashmead. It also differs from the others in the sculpture of the abdomen and nonfoveolate notauli.

Female.—Length 10 mm.; length of the ovipositor 8 mm. Anterior margin of the clypeus triangular in outline; middle of the face closely punctured, the sides shining with a few separated punctures; front, vertex, and orbits shining and with a few scattered punctures; a U-shaped fovea in front of the anterior ocellus; the dorsal aspect of pronotum irregularly striato-punctate; scutum and prescutum polished with a few scattered punctures; posterior part of prescutum irregularly striate; notauli not foveolate; suture in front of the scutellum foveolate; scutellum polished, with a few scattered punctures; propodeum irregularly rugoso-punctate; transverse apical carina strong; first tergite striato-punctate basally, the extreme apex without sculpture; basal middle of the second tergite with separate, poorly defined punctures, the remaining part of the second and all of the remaining tergite, polished. Black; legs below coxae (except that the femora are brownish) and abdomen beyond the first tergite rufous, wings brownish; venation dark brown; nervulus slightly antefurcal.

In the paratype the second and third tergites are brownish and the femora nearly black; antennae slightly longer than the abdomen.

Type locality.—Ashland, Oregon. Described from two females recorded under Bureau of Entomology number Hopk. U. S. 12020*h*. Material collected by G. Hofer as cocoons in larval galleries of some Buprestid in Mountain Mahogany (*Cercocarpus parvifolius*) and reared at Falls Church, Virginia, by Wm. Middleton.

APLOMERUS FOUTSI, new species.

This species is closely allied to *tibialis* Provancher but may be separated from it by the characters used in the foregoing table.

Female.—Length of body 10 mm.; length of ovipositor 10 mm. Face coarsely punctured, in the middle the punctures are sometimes confluent; front, vertex, and posterior orbits highly polished with a few scattered, poorly defined punctures; top and sides of pronotum striato-punctate; scutum, prescutum, scutellum, and mesepisternum polished with only a few scattered punctures; notauli completely foveolate; propodeum irregularly wrinkled, the usual carinae distinct but not prominent, basal area and the areola confluent; first and second tergites finely longitudinally striate, in the middle of the second tergite the striae curve so at the extreme apical middle they are transverse; the third and fourth tergites transversely aciculate. Black; palpi pale yellowish; legs except yellowish spot at the base to the four anterior tibiae rufous; first, second, and base of the third abdominal segments rufous; wings hyaline, faintly dusky, venation dark brown; nervulus antefurcal by one-fifth its length.

Type locality.—Cabin John, Maryland. One female collected by R. M. Fouts, for whom the species is named. One female paratype from Onaga, Kansas, Crevecoeur.

Type.—Cat. No. 20910, U.S.N.M.

APLOMERUS TIBIALIS (Provancher).

Platysoma tibialis PROVANCHER, Can. Ent., vol. 17, 1885, p. 115.
Aplomerus tibialis PROVANCHER, Addit. faun. Can. Hym., 1886, p. 120.—DAVIS, Proc. Acad. Sci. Phila. 1894, p. 190.

Type.—Entomological Branch, Department of Agriculture, Ottawa, Canada. A single female in good condition except the left antenna is wanting beyond the fifth joint. The notes on this species were taken from the unique type.

Notauli foveolated, body 10 mm. long; ovipositor 13 mm. long.

Vancouver Island.

(APLOMERUS) XORIDES NASONII Davis.

Aplomerus nasonii DAVIS, Trans. Amer. Ent. Soc., vol. 22, 1895, p. 32.

Type.—In the collection of Academy of Natural Science, Philadelphia.

This is the male of *Xorides calidus* (Provancher), see page 438.

Genus ODONTOMERUS Gravenhorst.

Odontomerus Gravenhorst, Ichneumon. Eur., vol. 3, 1829, p. 851. *Genotype.*—*Ichneumon dentipes* Gmelin.

The genus *Odontomerus* has been correctly recognized in America for many years. In 1870 Cresson tabulated the North American

species describing a few new species. Since then Provancher has described one new species and Rohwer has described five. As far as known all of the species are parasitic on wood-boring Coleoptera.

The genus is easily recognized by the dentate hind femora; all of the North American species are shining, with but little or no sculpture; the thorax is depressed, the notauli complete; antennae longer than the body; the apical part of the clypeus depressed forming a more or less distinct mouth opening; propodeum usually longer than scutum, always more or less areolated; in only one of the species the median carinae are wanting and the dorsal lateral angles but feebly toothed; propodeal spiracle elongate, well removed from the base; abdomen subpetiolate; ovipositor as long as or longer than the body; nervellus reclivous, broken at or below the middle; claws simple; middle tibiae, of female, twisted.

For the larger groups the best specific characters are to be found in the color; the areolation of the propodeum is subject to considerable variation and can not be considered as a specific character; in some of the species the costulae join the median carinae before their middle, while in others they unite with the median carinae behind the middle there is so much variation that this could not be used as a specific character; the position of the nervulus varies from antefurcal to postfurcal even within a species; the point of fracture of the nervellus is subject to some variation but is fairly constant within a species.

TABLE TO THE SPECIES.

1. Abdomen red........ 2.
   Abdomen black........ 6.
2. Legs entirely black........ *atripes* Rohwer.
   Legs mostly red........ 3.
3. Coxae and trochanters black........ *abdominalis* Cresson.
   Coxae and trochanters rufous........ 4.
4. Sides of the propodeum coarsely punctured; notauli strongly foveolate; base of second and third tergites transversely aciculate; median area of the propodeum not strongly angled and at least four times as long as basal width; propodeal tooth below the dorsal lateral angle........ *bicolor* Cresson.
   Sides of the propodeum finely punctured; notauli not or but very sparsely aciculate; median area of the propodeum sharply angulate and about three times as long as basal width; propodeal tooth on dorsal lateral angle........ 5.
5. Basal area almost completely closed posteriorly; posterior lateral face of scutellum and the depression of the metanotum without rugae; second recurrent more than the length of the intercubitus from the intercubitus...*strangaliae* Rohwer.
   Basal area indicated but not closed posteriorly; posterior lateral face of scutellum and depression of metanotum with rugae; the second recurrent the length of the intercubitus from the intercubitus........ *dichrous* Rohwer.
6. Legs entirely black........ 7.
   At least four anterior legs pale........ 8.
7. Male with the second and third tergites rather densely punctured; female stout; ovipositor longer than the body........ *aethiops* Cresson.
   Second and following tergites nearly impunctate........ *atripes* Rohwer male.

8. Median carinae of the propodeum obliterated; angles of the propodeum prominent but hardly toothed; legs red................................*alaskensis* Rohwer.
Median carinae of propodeum well developed; angles of propodeum toothed. 9.
9. Females.. 10.
Males.. 11.
10. Facial quadrangle (area between the eyes) with its width greater than or subequal with its length; ovipositor subequal with the length of the body; first tergite short and broader, seen from the side evenly arched and without a carina from the spiracle to the apex; postocellar line much shorter than ocellocular line. *mellipes* (Say).
Facial quadrangle with its length greater than its width; ovipositor distinctly longer than the body; first tergite lengthened, the chitinized part of the sternite extending well beyond the spiracle, and as seen from the side somewhat flattened with a complete or interrupted carina from the spiracle to apex. *canadensis* Provancher.
11. Hind legs black...*vicinus* Cresson.
At least the hind femora rufous.. 12.
12. Facial quadrangle with its width and length subequal or with the width greater; hind tibiae rufous..*mellipes* (Say).
Facial quadrangle longer than wide; hind tibiae usually black. *canadensis* Provancher.

ODONTOMERUS ATRIPES Rohwer.

Odontomerus atripes ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 358.

Type.—Cat. No. 15372, U.S.N.M.

This species is known only from the type material.

Franconia, New Hampshire; Princeton, Maine.

ODONTOMERUS ABDOMINALIS Cresson.

Odontomerus abdominalis CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 289.

Type.—Cat. No. 1527, Acad. Nat. Sci. Philadelphia.

This species is known only from the type material and the following notes are taken from the type.

Basal area and areola confluent; if the basal area were defined where it becomes confluent with the areola it would be twice as wide anteriorly as posteriorly; areola hexagonal, the posterior end straight; angles of the propodeum not sharply toothed; first tergite with sparse punctures; the following segments nearly impunctate; notauli not foveolate; nervellus broken below the middle.

Colorado.

ODONTOMERUS BICOLOR Cresson.

Odontomerus bicolor CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 169.

Type.—Cat. No. 1526, Acad. Nat. Sci. Philadelphia.

The characters given in the above table sufficiently distinguish this species from its allies. Besides the type material, two females from Call, Texas, reared from the bark of pine by W. F. Fiske, have been examined.

Canada; Pennsylvania (Cresson); Texas.

ODONTOMERUS STRANGALIAE Rohwer.

Odontomerus strangaliae Rohwer, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 158.

Type.—Cat. No. 18999, U.S.N.M.

Besides the type material this species is represented in the Museum by material from Montgomery County, Pennsylvania, and from Oswego, New York, from Rosslyn (H. H. Smith) and Falls Church (T. E. Snyder and Wm. Middleton) Virginia. Specimens collected at East Falls Church, Virginia, by Nathan Banks have also been examined.

Host.—*Strangalia luteicornis.*

ODONTOMERUS DICHROUS Rohwer.

Odontomerus dichrous Rohwer, Proc. U. N. Nat. Mus., vol. 45, 1913, p. 361.

Type.—Cat. No. 15375, U.S.N.M.

Besides the single type two females from Idaho have been examined. One was collected by R. W. Doane, the other, from Moscow, by C. V. Piper.

Washington, Idaho.

ODONTOMERUS AETHIOPS Cresson.

Odontomerus aethiops Cresson, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 289.

Type.—Cat. No. 1524, Acad. Nat. Sci. Philadelphia.

This species is easily recognized by its color; the female is short, stout, and has the propodeum shorter than mesoscutum; first tergite short, shaped much as it is in *mellipes* but there is a carina from the spiracle to the apex. Besides the type material a single female from Myer, California, reared by F. B. Herbert from a Cerambycid in lodge-pole pine (*Pinus murryana*) has been examined. Professor Cockerell tells me he has collected a female of this species in Peaceful Valley, Boulder County, Colorado, August 26, 1918.

Colorado, California.

ODONTOMERUS ALASKENSIS Rohwer.

Odontomerus alaskensis Rohwer, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 360.

Type.—Cat. No. 15373, U.S.N.M.

This species differs from all other American species of the genus by the obliterated median carinae of the propodeum. It is known only from the type material.

Sitka, Alaska.

ODONTOMERUS VICINUS Cresson.

Odontomerus vicinus Cresson, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 168.

Type.—Cat. No. 1525, Acad. Nat. Sci. Philadelphia.

This male may prove to be the opposite sex of one of the females which has a red abdomen, possibly *strangaliae*. Areola with a few transverse carinae; posterior lateral angle of the propodeum not

sharply toothed. Besides the type a specimen from the eastern United States, compared with the type, has been examined.

Massachusetts.

ODONTOMERUS MELLIPES (Say).

Anomalon mellips SAY, Contrib. Maclur. Lyc. Phila., vol. 2, 1828, p. 75.—LECONTE, ed. of Say, vol. 1, p. 378.
Odontomerus mellipes Say, CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 168.
Odontomerus errans ROHWER, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 360.

Say's type has been lost, but a neotype, designated by Rohwer (from Pennsylvania) which agrees with Say's description in all ways, is in the United States National Museum. The type of *errans* is Cat. No. 15374, U.S.N.M.

This species has an extremely characteristic habitus. It can be readily distinguished from *canadensis*, its nearest ally, by the characters mentioned in the foregoing table. *O. errans* Rohwer was separated in the original description by having the basal area and the areola separated by a transverse carina, but this character is subject to such variation that the species must be considered as a synonym of *mellipes* Say.

Pennsylvania; Flatbush, Long Island, New York; Washington, District of Columbia; South Dakota; French Creek, West Virginia (F. E. Brooks); Toronto, Canada (E. M. Walker); Priest River Lake, Idaho (Hopkins); Indiana (Say).

Host.—Reared from larvae of *Parandra brunnea* by F. E. Brooks.

ODONTOMERUS CANADENSIS Provancher.

Odontomerus canadensis PROVANCHER, Nat. Can., vol. 11, 1877, p. 102; Faun. Ent. Can., 1883, p. 490.

Type.—Female with label in the 1877 Provancher collection; and type, male, with name label and yellow label 426 in the second Provancher collection, Public Museum, Quebec.

As at present defined this species varies considerably; the females vary from 8 to 15 mm., and the length of the ovipositor from one-fourth to one-third longer than the abdomen, depending on the size of the specimen. Hind tibiae in the female vary from piceous black as in the type to rufous with some black at the ends to entirely rufous; in the male the hind tibiae are usually black but often are black with a rufous line beneath, while in occasional specimens they are almost entirely rufous; the areolation of the propodeum is also subject to considerable variation, especially the distance between the median carinae and the place where they are intersected by the costulae. Provancher and Cresson both separated this species from *mellipes* by the color of the tibiae, but inasmuch as this character is not specific they had specimens of *canadensis* labelled as *mellipes*. The species is closely allied to *mellipes* and can only be separated by the characters made use of in the foregoing table.

Host.—*Dicerca divaricata* Say; *Dicerca*, species in *Alnus; Leptura*, either *rubrica* or *vagans; Serropalpus*, species in fir. All these records

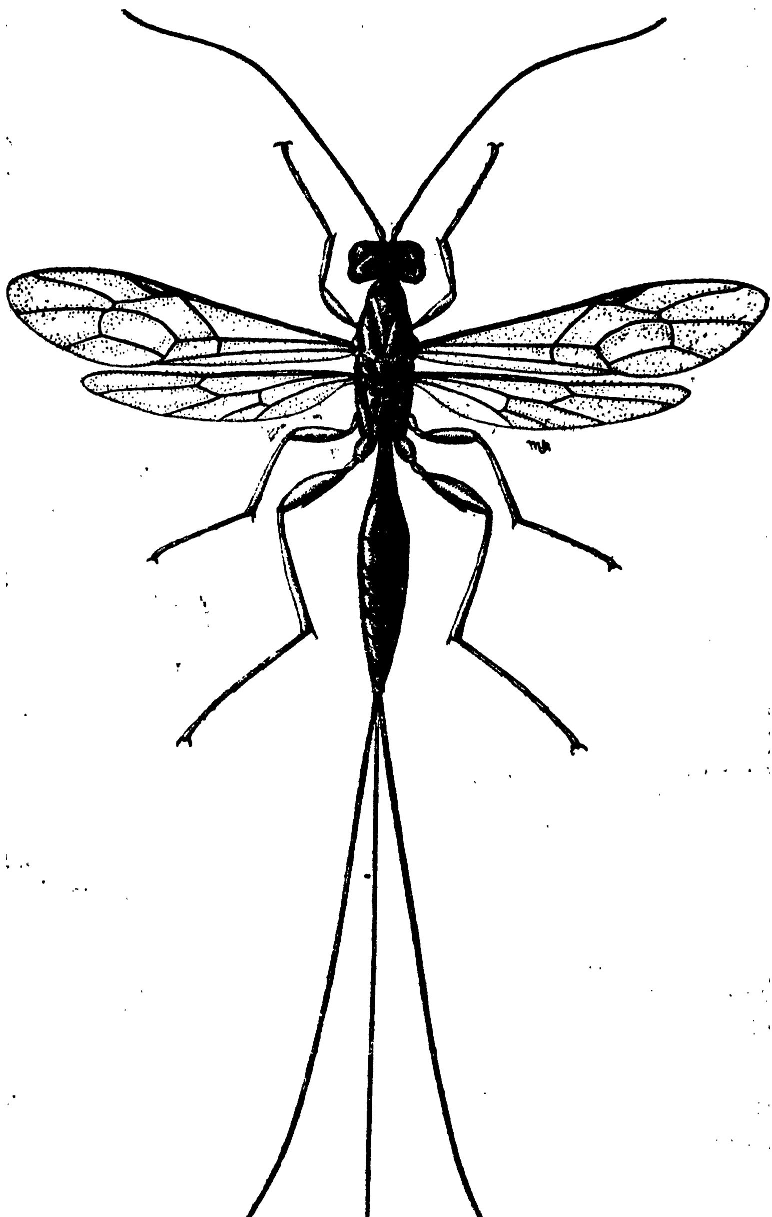

FIG. 12.—FEMALE OF ODONTOMERUS CANADENSIS PROVANCHER.

from the unpublished notes of the Branch of Forest Insects, Bureau of Entomology.

Canada, Vancouver Island; Northeast Pennsylvania (Cushman); Dixie Landing, Great Falls (Kirk), Hunter (Rohwer and Cushman), Rosslyn, Dead Run, (Shannon) Virginia; Pisgah (Fiske), Tryon (Fiske), North Carolina; Cromwall and Collins, Idaho (C. V. Piper); Oregon (Koebele); Austin, Oregon (Craighead).

Tribe PHYTODIETINI Cushman and Rohwer.

Phytodietini CUSHMAN and ROHWER, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 393.

Although the various species of the only genus of this tribe have been placed in different subfamilies by their describers, the genus has not been considered of tribal importance.

Gravenhorst allied the species of *Phytodietus* to members of the subfamily Cryptinae and there are certain characters which suggest such a relationship. The males, however, resemble closely some of the Tryphoninae, and it is not unlikely that future arrangements will place the Phytodietini close to some of the groups formed out of that heterogeneous complex.

As far as known all of the species belonging to the genus *Phytodietus* are parasitic on Lepidoptera; however but little is known concerning the condition of the host when attacked.

Tribal characters.—Comparatively small species with a smooth intergument; head transverse, the temples much narrower than cephalo-candad diameter of the eye; clypeus not sharply defined dorsally, convex, the apical portion not depressed; mandibles with two apical teeth; antennae long, slender, thorax short; scutum not quite as long as rest of middle part of body; mesepisternum much higher than long (cephalo-candad), the prepectal carina distinct, terminating about half way up on the mesepisternum and well behind its anterior margin; propodeum without carinae, the spiracles oval and well removed from the base; abdomen sessile, slightly compressed apically; hypopygidium not reaching apex of abdomen; ovipositor prominent, spear-like apically; sheath hairy; legs slender with long calcaria; claws rather short, curved and with about six long teeth; areolet rather small, triangular in outline.

Only one genus occurs in our fauna.

Genus PHYTODIETUS Gravenhorst.

Phytodietus GRAVENHORST, Ich. Eur., vol. 2, 1829, p. 928. *Genotype.*—*Phytodietus astutus* Gravenhorst (Westwood, 1840).

Generic characters.—Those to the tribe. Notauli present anteriorly as the scutum is trilobed cephalad; nervulus instertitial or nearly; nervellus perpendicular or slightly reclivous and broken below middle; third antennal joint longer than following joint; discocubitus strongly bent, but not angulate or with a ramulus.

The American species of *Phytodietus* are closely allied and, other than the structural characters offered in the following key, no charac-

ters other than color were observed. The small amount of material makes it difficult to determine just how variable the color is, and the following key, although it serves to distinguish the material at hand, is not entirely satisfactory. In the only case where a series reared from the same host is available, there is very little variation in color, thus suggesting that there are many incipient species in the genus. On the other hand, however, larger collections and more rearings may prove that too many species are now recognized.

TABLE TO SPECIES.

1. Hind coxae black...*clypearius* Ashmead.
   Hind coxae rufous or yellow with a line above.............................. 2.
2. Males.. 3.
   Females.. 7.
3. Hind coxa yellow with a black spot posteriorly; flagellum testaceous; thorax with abundant yellow marks.................................*pulcherrimus* (Cresson).
   Hind coxa rufous; flagellum black or piceous, throacic markings whitish..... 4.
4. A distinct yellow spot posterior to origin of hind wing............*burgessi* (Cresson).
   No yellow spot posterior to origin of hind wing............................ 5.
5. Propodeum entirely black; hind femora not black basally.....*pleuralis* Cresson.
   Propodeum with yellow marks posteriorly..................................... 6.
6. Sides of propodeum black; a black band at base of hind femur; second and third tergites subequal.................................*annulatus* (Provancher).
   Sides of propodeum rufous; hind femur without a black band basally; third tergite shorter than second...*vulgaris* Cresson.
7. Inner orbits lined with yellow; if line is interrupted, the hind femur is entirely rufous.. 8.
   Inner orbits black or with a small yellow spot dorsally; hind femur with a black preapical band... 9.
8. Hind femur with a black preapical band followed by an apical band of yellow; sides and lower part of thorax rufous...........................*facialis* Rohwer.
   Hind femur uniformly rufo-ferruginous; sides of thorax mostly black. *distinctus* Cresson.
9. Anterior basitarsi half or slightly more than half as long as their tibiae; small species.. 10.
   Anterior basitarsi fully two-thirds as long as their tibiae.................... 12.
10. Clypeus black; inner margins of eyes not converging below; propodeum with a longitudinal depression dorsally.............................*parvus* Rohwer.
    Clypeus yellow; inner margins of eyes slightly converging below; propodeum without a dorsal longitudinal depression..................................... 11.
11. Second and third tergites subequal in length; band on tergites 1 to 4 reduced to testaceous lines; mesosternum and lower part of episternum black. *californicus* Cresson.
    Third tergite distinctly shorter than the second; bands on tergites distinct, yellow; mesosternum and lower part of mesepisternum reddish........*pleuralis* Cresson.
12. Mesepisternum with a broad yellow line below.........................*plesia* Rohwer.
    Mesepisternum below, the sternum and sides of propodeum rufous. *burgessii* (Cresson).
    Mesepisternum (except a small spot posteriorly) and sternum black.......... 13.
13. Species slender; second and third tergites of subequal length. *annulatus* (Provancher).
    Species robust; third tergite distinctly shorter than the second.....*vulgaris* Cresson.

PHYTODIETUS CLYPEARIUS Ashmead.

Phytodietus clypearius ASHMEAD, Proc. Wash. Acad. Sci., vol. 4, 1902, p. 195.
Phytodietus flavifrons ASHMEAD, Proc. Wash. Acad. Sci., vol. 4, 1902, p. 196.

Type of clypearius.—Cat. No. 5612, U.S.N.M., one female in good condition and one female with abdomen wanting, labeled as allotype male. *Type of flavifrons.*—Cat. No. 5613, U.S.N.M., one male in good condition.

There can be but little reason to doubt that *flavifrons* is the male of *clypearius* and that the specimen with the abdomen wanting, considered by Ashmead as the male of *clypearius* is a female. The color and general appearance of this specimen is that of a female and not a male.

The black hind coxae readily distinguish this species from all the other North American forms. Known only from the type material which was collected by T. Kincaid at Yakutat and Orca, Alaska.

PHYTODIETUS PULCHERRIMUS (Cresson).

Mesoleptus pulcherrimus CRESSON, Trans. Amer. Ent. Soc., vol. 2, 1868, p. 101.
Phytodietus pulcherrimus PROVANCHER, Natural. Canad., vol. 12, 1880, p. 81.
Ctenopelma pulchra ASHMEAD, Trans. Amer. Ent. Soc., vol. 22, 1896, p. 198.
Phytodietus pulchra DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 340.

Type of pulcherrimus.—Cat. No. 1509, Acad. Nat. Sci., Philadelphia. *Type of pulchra.*—Cat. No. 22161, U.S.N.M.

This distinct species is known only in the male, but it does not seem likely that it can be the male of any of the species treated in this paper. Cresson's type came from Connecticut, Ashmead's from Massachusetts, and there are in the National collection two specimens from Vienna, Virginia, collected June 4, 1913, by R. A. Cushman.

PHYTODIETUS FACIALIS, new species.

The abundant markings distinguish this species from all other North American forms, but suggest that it is more closely allied to *distinctus* Cresson, from which it may be readily separated by the black band on the hind femur.

Female.—Length, 7 mm.; length of ovipositor, 2.5 mm. Inner margins of the eyes parallel; clypeus polished, postocellar line distinctly longer than the ocellocular line; ocelli not especially prominent; anterior basitarsi fully two-thirds as long as their tibiae; longer calcarium of hind tibia more than half as long as hind basitarsus; areolet petiolate; first tergite rather short; third tergite distinctly shorter than the second. Black, with luteous and red markings; head black, mandibles (except apices), two spots on clypeus, face, except just above clypeus and a W-shaped mark dorsally, inner orbits to vertex and cheeks luteous; antennae black, the three basal joints beneath luteous, flagellum apically beneath brownish; thorax

black, cuneiform spots on scutum anteriorly, tegulae, a spot before and below, dorsal and ventral margins of pronotum, wedge-shaped spot on scutum posteriorly, sides and apex of scutellum, metascutellum, two spots on metanotum behind origin of hind wings, U-shaped spot on propodeum posteriorily and prepectus luteous; sternum, sides of mesepisternum below, and sides of propodeum reddish; abdomen black, complete apical margins of tergites, and all sternites except the first basally, luteous; legs reddish, apices of intermediate tibiae and their tarsi, a preapical band on hind femur (followed by a luteous apical band), hind tibiae, except luteous basal and median annuli, and hind tarsi, except most of basitarsi, which are luteous, blackish; wings hyaline, iridescent, venation dark brown, stigma pale brown.

Type locality.—Louisiana. Described from one female.

Type.—Cat. No. 22162, U.S.N.M.

PHYTODIETUS DISTINCTUS Cresson.

Phytodietus distinctus CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 166.
Phytodietus zonatus PROVANCHER, Natural. Canad., vol. 6, 1874, p. 79.
Mesostenus nobilis PROVANCHER, Natural. Canad., vol. 13, 1882, p. 363.
Mesoleius telarius PROVANCHER, Addit. fauna Canad. Hym., 1886, p. 106.
Phytodietus nobilis DAVIS, Proc. Acad. Nat. Sci. Phila., 1894, p. 187.
Phytodietus telarius DAVIS, Proc. Acad. Nat. Sci. Phila., 1894, p. 189.

Type of distinctus.—Cat. No. 1507, Acad. Nat. Sci. Phila. *Type of zonatus.*—Yellow label 514 first Provancher collection, of *nobilis* yellow label 1049 second Provancher collection, of *telarius* yellow label 1241 second Provancher collection, Public Museum, Quebec.

This species is recorded from Cap Rouge and Becancour, Canada, by Provancher and from Massachusetts and Delaware by Cresson. Other than the various types no specimens have been examined.

PHYTODIETUS PARVUS, new species.

This species is closely allied to *californicus* Cresson and *pleuralis* Cresson, but can be distinguished by the characters used in the above key.

Female.—Length, 4 mm.; length of ovipositor 1.25 mm. Clypeus shining, with sparse punctures; face more distinctly sculptured medially; inner margins of eyes parallel or slightly nearer together opposite bases of antennae; ocelli prominent; postocellar line but little longer than the ocellocular line; anterior basitarsi but little more than half as long as their tibiae; longer calcaria of hind tibiae about two-thirds as long as their basitarsi; areolet shortly petiolate; first tergite short; second and third tergites subequal in length. Black; palpi, mandibles (except apices), a small spot on inner superior orbits, elongate spots on anterior margin of scutum, tegulae, a spot before, apex of scutellum and two small basal spots, metascutellum,

narrow apical margins of tergites (interrupted laterally on basal ones), and most of the sternites luteous; spot on mesepisternum posteriorly and side of propodeum rufous; legs rufous, anterior coxae and trochanters, intermediate and posterior trochanters, base and most of exterior surface of hind tibiae and base of two basal joints of hind tarsi luteous; remaining parts of hind tibiae and tarsi dusky; apices of hind femora above brownish; wings hyaline, slightly dusky; venation, including stigma, dark brown.

Type locality.—Siskiyou County, California. Described from one female.

Type.—Cat. No. 22163, U.S.N.M.

PHYTODIETUS CALIFORNICUS Cresson.

Phytodietus californicus Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 380.

Type.—Cat. No. 1512, Acad. Nat. Sci. Philadelphia.

Inner margins of eyes slightly converging toward the clypeus; anterior basitarsi but little more than half as long as their tibiae; longer calcarium of hind tibia about two-thirds as long as the hind basitarsus, second and third tergites subequal in length.

This species is known only from the type which came from California, and one female collected at Easton, Washington, by A. Koebele.

PHYTODIETUS PLEURALIS Cresson.

Phytodietus pleuralis Cresson, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 266.

Type.—Cat. No. 1510, Acad. Nat. Sci. Philadelphia.

Female.—Length, 4.5 mm.; length of ovipositor, 1.75 mm. Inner margins of eyes slightly converging to clypeus; postocellar line slightly longer than ocellocular line; anterior basitarsi a little more than half as long as their tibiae; longer calcarium of hind tibia but little more than half as long as its basitarsus; first tergite short; third tergite distinctly shorter than the second. Black; palpi, mandibles, clypeus, small spot on inner superior orbits, small spots on anterior margin of scutum, apex of scutellum, tegulae, a spot before, narrow line on metanotum, narrow apical margins of tergites and sternites broadly, luteous; sternum, lower part of mesepisternum and sides of propodeum ferrugineous; apex of hind femora above, base and apex of hind tibiae and apex of hind tarsi brownish; trochanters and base of hind tarsi whitish; wings hyaline; venation dark brown.

This species is known only from the type male which came from Colorado and the single female, also from Colorado, described above.

Riley and Howard,[1] record *Eudemis botrana* as the host of this species but the specimen on which this record is based was erroneously determined. The record should refer to *P. burgessii* Cresson, given below.

[1] Ins. Life, vol. 3, 1891, p. 464.

PHYTODIETUS BURGESSI (Cresson).

Tryphon burgessii Cresson, Trans. Amer. Ent. Soc., vol. 2, 1868, p. 105.
Phytodietus ? burgessii Davis, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 347.

Type.—Cat. No. 1508, Acad. Nat. Sci. Philadelphia.

Female.—Length, about 7 mm.; ovipositor about 3.5 mm. Slender; inner margins of the eyes parallel; ocelli prominent; postocellar line about one-fourth longer than ocellocular line; anterior basitarsi fully two-thirds as long as their tibiae; second and third tergites subequal in length; longer calcarium of hind tibia about half as long as hind basitarsus; ovipositor somewhat shorter than abdomen. Black; palpi, mandibles, elongate spots on inner superior orbits, cuneiform spots on anterior margin of scutum, tegulae, spot before, sides and apex of scutellum, metascutellum, spot on metanotum behind posterior wing, U-shaped spot on posterior face of propodeum, apical margins of tergites and sternites broadly luteous; sternum, lower part of mesepisternum and sides of propodeum rufous; legs rufous; anterior coxae four anterior trochanters, apical joint of posterior trochanters, apex of posterior femora, base and exterior part of posterior tibiae and basal part of two basal joints of hind tarsi whitish; basal joint of hind trochanters, basal and preapical band on hind femur and most of hind tarsus blackish; wings hyaline; venation pale brown.

Male.—In the male the rufous color of the thorax and anterior legs is largely replaced by yellowish; the face, inner orbits, cheeks, scape and pedicellum beneath and ventral margin of pronotum are luteous.

This species was originally described from a single male collected in Massachusetts. Specimens in the National Collection came from the following localities: "Canada," "New York," "Pennsylvania," Charter Oak, Pennsylvania (W. S. Fisher); Montclair, New Jersey (W. D. Kearfott); Washington, District of Columbia; Trout Lake, Wisconsin (J. J. Davis); and Texas (Belfrage).

Hosts.—*Polychrosis liriodendrana* Kearfott on Liriodendron (recorded by Riley and Howard under name *P. pleuralis* Cresson with the host given as *Eudemis botrana* Schiffermüller); *Exartema myricanum* (reared by Kearfott); and a lepidopteran on chestnut (reared by Fisher).

PHYTODIETUS PLESIA, new species.

This form is closely allied to *burgessii* (Cresson) but besides the color differences mentioned in the key it differs in the somewhat longer ovipositor and shorter third tergite.

Female.—Length, 8 mm.; length of ovipositor, 4.25 mm. Eyes large, their inner margins slightly closer together slightly below the antennae; face punctured on a granular surface; ocelli prominent; postocellar line one-fourth longer than ocellocular line; anterior

basitarsi fully two-thirds as long as their tibiae; longer calcarium of hind tibia a very little more than half as long as hind basitarsus; first tergite one and two-thirds times as long as basal width; third tergite distinctly shorter than the second; ovipositor somewhat longer than the abdomen. Black; palpi, mandibles except apices, elongate spots on inner superior orbits, cuneiform spots on scutum anteriorly, tegulae, a spot in front and one below, sides and apex of scutellum, metascutellum, spot on metanotum behind posterior wing, U-shaped spot on posterior face of propodeum, prepectus, band on mesepisternum below, apical margins of tergites (complete and broader on basal ones, interrupted laterally on apical ones) and apical margins of the sternites luteous; sides of propodeum rufous; legs rufous, anterior coxae and trochanters, apical joint of posterior trochanters, apices of hind femora, base and exterior face of hind tibiae, basal part of joints of hind tarsi luteous; anterior tibiae and tarsi testaceous; dorsal spot on apex intermediate femora, narrow apex of intermediate tibiae and basitarsi, básal joints of hind trochanters, base and a preapical band of hind femora, hind tibiae and tarsi except where luteous, blackish; wings hyaline; venation brown, stigma yellowish.

Type locality.—Riley County, Kansas. Described from one female collected May 22, by Popenoe.

Type.—Cat. No. 22169, U.S.N.M.

PHYTODIETUS ANNULATUS (Provancher).

Mesoleius annulatus PROVANCHER, Addit. faun. Can. Hym., 1886, p. 108.

Type.—Yellow label 1242 second Provancher collection, Public Mus. Quebec.

Davis [1] considered this to be the same as *vulgaris* Cresson but it is a more slender species and may be distinguished by characters given in the above key.

Slender; eyes prominent, their inner margins parallel; ocelli prominent, postocellar line about one-fourth longer than the ocellocular line; anterior basitarsi but little shorter than their tibiae; first tergite slender about one and two-thirds times as long as apical width; second and third tergites subequal in length; ovipositor distinctly shorter than the abdomen; longer calcarium of hind tibia somewhat more than half as long as hind basitarsus.

Male.—Length, 5 mm. Structure as above. Black; palpi, mandibles (except piceous tips) scape and pedicellum beneath, clypeus, face, inner orbits, cheeks, cuneiform mark on anterior margin of scutum, sides and apex of scutellum, metascutellum, lateral spots on posterior face of propodeum, tegulae, spots before and below, wing process, lower margin of pronotum, mesosternum and lower part of episternum and apical margins of tergites and sternites whitish; legs ferrugineous;

[1] Proc. Acad. Nat. Sci. Phila., 1894, p. 189.

four anterior coxae and trochanters, apical joint of hind trochanters, apex of hind femur, base of hind tibia white; basal joint of hind trochanter, base and preapical band on hind femur, most of hind tibia and all of hind tarsus blackish; wings hyaline, venation dark brown.

Distribution.—Discussion based on the type, which came from Ottawa, Canada, and specimens from the following localities: Canada;

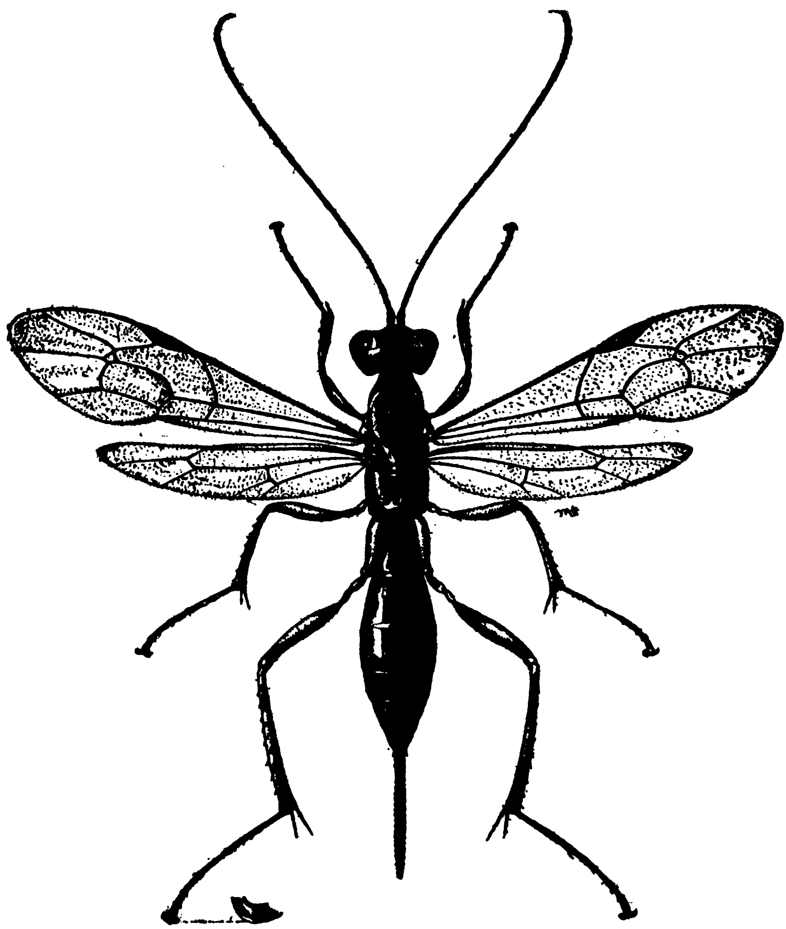

FIG. 13.—FEMALE OF PHYTODIETUS ANNULATUS (PROVANCHER).

Oswego, Ithaca, and Watkins, New York; Durham and Franconia, New Hampshire; Pennsylvania; Kirkwood, Missouri; Ohio.

Hosts.—Geometrid on *Physalis viscosa* (recorded as a host of *Phytodietus vulgaris* by Riley and Howard).[1] *Eulia pinatubana* from material reared at Ithaca, New York, by A. Hartzell. This material contains specimens said to be larval parasites and also specimens said to be pupal parasites.

[1] Ins. Life, vol. 3, 1891, p. 464.

PHYTODIETUS VULGARIS Cresson.

Phytodietus vulgaris Cresson, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 166.

Type.—Cat. No. 1506, Acad. Nat. Sci. Philadelphia.

Inner margins of eyes parallel; anterior basitarsus fully two-thirds as long as tibia; longer calcarium of hind tibia distinctly more than half as long as hind basitarsus; third tergite distinctly shorter than the second; ovipositor somewhat shorter than the abdomen but varying somewhat in the specimens examined.

The male assigned to this species has not been definitely associated with the female, but it agrees so well with the female and is so closely allied to *annulatus* that it seems fair to assume that the association is correct.

Distribution.—Cresson records this species from Canada, Massachusetts, Connecticut, Pennsylvania, Delaware, and Illinois, but not all of his specimens belong to the species as here restricted. The specimen from Delaware was labeled by Cresson as lectotype. Specimens in the National Collection come from the following localities: Agricultural College, Michigan; Westville and Pemberton (Scammell), New Jersey; Washington, District of Columbia; and Chain Bridge, Virginia (Wm. Middleton).

Hosts.—Erroneously recorded by Riley and Howard from a geometrid on *Physalis viscosa* (see *Phytodietus annulatus*). Recorded as a parasite of *Eucosma ocellana*,[1] *Cacoccia* (*Archips*) *argyrospila* Walker[2] and *Peronea minuta*.[3] One male in the National Collection was reared by Scammell as a parasite of *Peronea minuta*.

SPECIES ERRONEOUSLY REFERRED TO THE GENUS.

(PHYTODIETUS) PLECTISCUS GRACILIS (Provancher).

(PHYTODIETUS) LISSONOTA? TRUNCATA (Davis).

Phytodietus? truncatus Davis, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 371.

I have not been able to locate the type of this species but the description makes it reasonably certain that the species does not belong to *Phytodietus*.

(PHYTODIETUS) LISSONOTA OBSCURELLUS (Cresson).

Phytodietus obscurellus Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 379.

HOST CATALOGUE.

The following is a list of the various insect hosts referred to in this paper:

COLEOPTERA.

ALAUS OCULATUS Linnaeus.

Xorides catomus (Davis).

[1] Duporte, 7th Ann. Rept. Quebec Soc. Prot. Plants, 1915, pp. 76–77.
[2] Herrick and Leiby, Cornell Univer. Agr. Exp. Sta. Bull. 367, 1915.
[3] Franklin and Morse, Mass. Agr. Exp. Sta. Bull. 150, 1914.

ATIMIA DORSALIS LeConte.

Deuteroxorides borealis (Cresson).
Xorides insularis (Cresson).

BUPRESTID in CERCOCARPUS PARVIFOLIUS.

Aplomerus buprestivorus Rohwer.

BUPRESTID in DOUGLAS FIR.

Deuteroxorides borealis (Cresson).

BUPRESTIS LAEVIVENTRIS LeConte.

Xorides californicus (Cresson).

CALLIDIUM AEREUM Newman.

Xorides rileyi (Ashmead) form B.

CERAMBYCID in BOXELDER.

Xorides humeralis (Say).

CERAMBYCID in CHESTNUT.

Deuteroxorides borealis (Cresson).

CERAMBYCID in PINUS MURRYANA.

Odontomerus aethiops Cresson.

CERASPHORUS CINCTUS Fabricius.

Labena grallator (Say). Record somewhat doubtful.

CHALCOPHORA ANGULICOLLIS LeConte.

Xorides catomus (Davis).

CHRYSOBOTHRIS FEMORATA Fabricius.

Labena confusa var. *minor* Rohwer.
Labena grallator (Say).
Xorides calidus (Provancher).

CURIUS DENTATUS Newman.

Xorides calidus (Provancher).

DICERCA SPECIES in ALNUS.

Odontomerus canadensis Provancher.

DICERCA DIVARICATA Say

Odontomerus canadensis Provancher.

DORCHASCHEMA NIGRUM Say.

Deuteroxorides caryae (Harrington). This record is probably wrong.

GRAPHISURUS FASCIATUS De Geer.

Deuteroxorides vittifrons (Cresson).

HYLOTRUPES LIGNEUS Fabricius.

Deuteroxorides borealis (Cresson).
Xorides insularis (Cresson).

HYLOTRUPES AMETHYSTINUS LeConte.

Xorides insularis (Cresson).

LEPTOSTYLUS MACULUS Say.

Xorides calidus (Provancher).

LEPTURA species (probably CHRYSOCOMA).

Xorides cincticornis (Cresson).

LEPTURA species, either RUBRICA or VAGANS.

Odontomerus canadensis Provancher.

LEPTURA species in PINUS PONDEROSA.

Poemenia vancouverensis (Provancher).

LEPTURA NITENS Forster.

Xorides rileyi (Ashmead), form B.

LEPTURA PROXIMA Say.

Xorides stigmapterus (Say).

LIXUS STROBICOLLIS Boheman.

Labena apicalis Cresson.

MELANOPHILA DRUMMONDI Kirby.

Xorides insularis (Cresson).

NEOCLYTUS CAPRAEA Say.

Xorides neoclyti Rohwer.

PARANDRA BRUNNEA Fabricius.

Odontomerus mellipes (Say).

PARATIMIA CONICOLA Fisher.

Poemenia americana (Cresson).

PHYMATODES VARIUS Fabricius.

Xorides humeralis (Say).

PHYSOENEMUM ANDREA Haldemann.

Xorides ruficoxis (Rohwer).

ROMALEUM ATOMARIUM Drury.

Xorides rileyi (Ashmead), form C.

SAPERDA DISCOIDEA Fabricius.

Deuteroxorides caryae (Harrington).
Xorides albopictus (Cresson).

SERROPALPUS species.

Rhyssa persuasoria (Linnaeus). Record open to question as association not definitely proven.

SERROPALPUS species in FIR.

Odontomerus canadensis Provancher.

STRANGALIA LUTEICORNIS Fabricius.

Odontomerus strangaliae Rohwer.

TETROPIUM CINNAMOPTERUM Kirby.

Xorides insularis (Cresson).

TETROPIUM VELUTINUM LeConte.

Deuteroxorides borealis (Cresson).
Xorides insularis (Cresson).

THRINCOPYGE ALACRIS LeConte.

Labena confusa Rohwer.

XYLOTRECHUS COLONUS Fabricius.

Xorides rileyi (Ashmead) form A.

HYMENOPTERA.

CERATINA DUPLA Say.

Grotea anguina Cresson.

CRABRO species in RASPBERRY.

Grotea anguina Cresson.

SIREX species in PINUS VIRGINIANA.

Rhyssa persuasoria (Linnaeus).

TREMEX COLUMBA (Linnaeus).

Megarhyssa greenei Viereck.
Megarhyssa lunator (Fabricius).

XERIS species in SPRUCE.

Rhyssa lineolata (Kirby).

XERIS species in ABIES CONCOLOR.

Megarhyssa nortoni (Cresson).
Rhyssa persuasoria (Linnaeus).

XIPHYDRIA ABDOMINALIS Say.

Rhyssella humida (Say).

XIPHYDRIA ATTENUATA Norton.

Rhyssella humida (Say).

XIPHYDRIA ERYTHOGASTRA Ashmead.

Rhyssella humida (Say).

XIPHYDRIA MACULATA Say.

Rhyssella nitida (Cresson).

LEPIDOPTERA.

GEOMETRID on PHYSALIS VISCOSA.

Phytodietus annulatus (Provancher).

LEPIDOPTERAN on CHESTNUT.

Phytodietus burgessii (Cresson).

CACOECIA (ARCHIPS) ARGYROSPILA Walker.

Phytodietus vulgaris Cresson.

EUCOSMA OCELLANA.

Phytodietus vulgaris Cresson.

EULIA PINATUBANA.

Phytodietus annulatus (Provancher).

EXARTEMA MYRICANUM.

Phytodietus burgressii (Cresson).

LASPEYRESIA TOREUTA Grote.

Deuteroxorides borealis (Cresson). Record needs verifying.

Poemenia americana (Cresson). Record open to question, needs verification.

MEMYTHRUS PERLUCIDA Busck.

Xorides catomus (Davis). Host association not positively proven.

PERONEA MINUTA.

Phytodietus vulgaris Cresson.

POLYCHROSIS LIRIODENDRANA Kearfott.

Phytodietus burgessii (Cresson).

INDEX.

This index includes all of the species referred to in this paper. Accepted genera are in bold face type; accepted species in roman, while synonyms are given in italics.

PETROGRAPHY OF SOME LAMPROPHYRIC DIKE ROCKS OF THE COEUR D'ALENE MINING DISTRICT, IDAHO.

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INTRODUCTION.

Most of the occurrences upon which the following descriptions are based were examined by the writer in and around the mines of the Coeur d'Alene District in the summer of 1917. Ransome and Calkins[1] had done much work in the region, mapping the dikes in a single color and stating in their text that certain of the rocks were most properly called minettes, while others were nearer kersantite. Later Dr. Joseph B. Umpleby of the United States Geological Survey turned over to the Museum all specimens collected by him in the course of his field work in this region. Inasmuch as other duties have necessitated that publication of results by Doctor Umpleby be indefinitely postponed, descriptions of his material are included in the present paper. There had already been deposited in the United States National Museum the specimens of these rocks collected by Mr. F. C. Calkins in his work in the Coeur d'Alene Region, and permission was kindly extended by him to reexamine these and to redescribe such as might be of interest in connection with the present work. There were thus available specimens from a large proportion of the dikes which occur in the producing area. The descriptions are based entirely upon museum material.

While the following paper contains much rather monotonously descriptive matter, it relates to a group of igneous rocks of uncommon interest. The observations recorded are made as complete as possible for the reason that a great number of the dikes which occur associated with important ore-bodies have been made visible only in mine workings, and the great majority of mines in which they occur have been exhausted and abandoned and their workings rendered permanently inaccessible. Thus the student of this particular district may find here recorded evidence which is no longer obtainable in the field.

These black ferromagnesian rocks have been locally designated by various names as syenite, diorite, diabase, etc. The rock from the

[1] Ransome, F. L., and Calkins, F. C., Prof. Paper, U. S. Geol. Survey, No. 62, 1908.

Hecla dike is locally called "black porphyry," a not inappropriate name. The present studies seem to indicate that the hornblendic and the biotitic rocks form two fairly distinct classes and intermediate rocks are somewhat rare. Spessartites are somewhat more abundant than minettes and kersantites and vogesites are quite exceptional.

GENERAL OUTLINE OF THE GEOLOGY OF THE REGION.

The chief aim of the original field work was to endeavor to develop some logical theory in regard to the genetic relation of the lamprophyric rocks to the ore-bearing veins of the district and to the monzonitic rocks which are presumed to have supplied the ore-depositing solutions.

The areal and economic geology of the region have been described in detail by Ransome and Calkins, and it is necessary here only to mention in bare outline the broader features of the areal geology. The district occupies a portion of the large area of pre-Cambrian rocks which covers the greater portion of northern Idaho and northwestern Montana. These sediments, which are of Algonkian age, comprise a vast thickness of beds known collectively as the Belt Terrane. In the Coeur d'Alene District these rocks were divided by Calkins into the following members, the divisions being based upon lithologic characters:

Formation.	Thickness.
	Feet.
Striped Peak; red and green flaggy sandstones and shales, top eroded	1,000
Wallace; mainly calcareous shale with some limestone	4,000
St. Regis; green and purple shales and sandstones	1,000
Revett; pure white thick-bedded quartzites	1,200
Burke; greenish sericitic slates and thin-bedded sericitic quartzites	2,000
Prichard; blue-black slates quartzites and argillites, base not exposed	8,000
Total	17.200

The important ore bodies occur mainly in the lower formations, the Prichard, Burke, and Revett, a condition which is probably in some measure influenced by the lithologic character of the formations but is apparently more because, at the time of deposition of the ores, the rocks of the higher formations in very few cases were in a position to be reached by the ore-bearing solutions before their load of dissolved minerals had been exhausted. Most of the areas occupied by the lower formations as exposed at the present surface occupy islandic horsts which are partly surrounded by graben of the higher formations which have been faulted down by gigantic post-mineral faults. If commercial ore-bodies exist in these depressed

blocks they have been dropped downward far beyond the reach of mining exploration.

The igneous rocks are present in small amount. Chief among them is a group of granitic rocks ranging from syenite to quartz-monzonite or quartz-monzonite prophyry in composition, which occurs as a number of small areas which presumably are upward projections of a single small batholith. The intrusion is very long as compared with its width and trends in a northeasterly direction. Calkins states that its exposure is probably the axis of a very old flat anticline which has largely been obliterated by later deformation. This monzonitic intrusion has been regarded by Ransome and others as the most probable source of the metalliferous ores of the district. Hershey[1] discredits the theory that the ore minerals were derived from the igneous rock and applies a modification of the older lateral-secretion theory which implies that the lead and zinc were derived by leaching from a certain narrow horizon in the upper Prichard formation in which these metals were present in some form as an original clastic constituent. In his latest paper, which, unfortunately, is generally inaccessible to the majority of persons who might be interested in the subject, Mr. Hershey contends that the ores are older than the Coeur d'Alene monzonite intrusions, and further that the contact-metamorphism of the Ninemile area is distinctly older than the intrusive rock at present exposed and likewise older than the ores which the metamorphic silicates inclose. His evidence seems to, in part, substantiate these latter conclusions, although his views as to the source of the metallic minerals have met with no general acceptance even upon consideration of his complete evidence.

Ransome believed that the Coeur d'Alene batholith was an upward projection of the continuation of the Central Idaho batholith which he assumed to underlie the entire district. In part from the modified conclusions of both Ransome and Hershey, we may derive the following succession of events:

1. Intrusion of the central Idaho batholith, extending under the Coeur d'Alene region to connect with the Priest Lake batholith to the north, probably with an upward extension beneath the center of the Coeur d'Alene area.

2. A renewed upward advance of the column of magma under the central portion of the Coeur d'Alene district, giving off emanations which produced intense local metamorphism in the overlying rocks.

3. Deposition of the ores by solutions given off by the underlying igneous rock of the Coeur d'Alene.

[1] Genesis of lead-silver ores in Wardner District, Idaho. Min. and Sci. Press, June 1, 8, and 15, 1912. Origin of Lead, Zinc, and Silver in the Coeur d'Alene, Min. and Sci. Press, Sept. 27 and Oct. 4, 1913. Origin and Distribution of Ore in the Coeur d'Alene, Private Pub., San Francisco, 1916.

4. Continued upward advance of the magma column, giving the Coeur d'Alene batholith as it at present exists.

5. Slight subsidence of the region and intrusion of the lamprophyric dikes.

6. Beginning of long-continued subsidence, giving great structural faults.

As suggested by Stewart[1] the fact that the rocks of the Coeur d'Alene intrusion present some essential differences from the main mass of granitic rock in Idaho indicates that some differentiation had probably taken place before it was intruded.

THE LAMPROPHYRE DIKES.

The lamprophyric dike rocks are widely distributed in the Coeur d'Alene region as well as in a large part of the surrounding territory. They are most abundant in the Prichard formation, are common in the lower Burke, and are increasingly rare higher in the series. Those which have reported from the formations above the Burke are doubtful, as they are thoroughly decomposed and may belong to the diabases rather than to the lamprophyres.

As is well known the group of rocks called lamprophyres belongs to the class known as diaschistic or complementary instrusives and results from the tendency of a magma of medium composition to separate into two components by the process of gravitative differentiation, a mafic division containing the majority of the ferromagnesian minerals, and represented by lamprophyres, and a felsic division consisting of the more acidic light-colored constituents of the rock and represented by aplites in the case of a normal granite or granodiorite. The presence of lamprophyric rocks in wide distribution over the Coeur d'Alene region constitutes the strongest argument in support of the assumption that the region is underlain by a granitic batholith. Yet from a batholith of the composition of the granitic rock of central Idaho aplites should be expected to form at least twice as much of the volume of the complementary rocks as lamprophyres. Aplites are not definitely known to occur in the Coeur d'Alene district, although Hershey has mentioned some very much decomposed dikes which may originally have been of aplitic character. As to why lamprophyres should be so abundantly represented while aplites are almost, or quite, absent, the explanation probably lies in the well-recognized fact that mafic magmas are fluid at much lower temperatures than are acidic magmas. It is probable that the lamprophyres did not extend much above the level of the present erosion surface and that they were enabled to reach their present position because they were fluid at temperatures below the crystallizing point of aplites which solidified at much greater depth. The

[1] Journal of Geology, vol. 22, No. 7, p. 684.

mixed character which characterizes many of the dikes may be construed to show that when they reached their present position they had already cooled to the extent of partial crystallization and lumps of solidified material were carried forward mixed with more fluid fused magna in a pasty mass yielding solid bodies of more or less agglomeratic texture.

The age relations of the lamprophyres are rather definitely fixed by the work of Hershey on the age of the Coeur d'Alene batholith in relation to the ores and by the fact that both the ore-bearing veins and the Coeur d'Alene batholith itself are cut by typical lamprophyric dikes. The whole series of events, tabulated above, from the first underlying intrusion to the injection of the lamprophyric dikes must have occupied a relatively short period of time. That the period of mineralization had not entirely closed before the intrusion of the basic dikes is evidenced by the fact that the dikes are all affected by hydrothermal alteration, some of them to an extreme degree.

The lamprophyres occupy narrow dikes rarely more than 10 feet in width and seldom traceable along the strike for more than half a mile. The majority of them strike in a northwesterly direction and dip steeply to the southwest, but exceptions to this rule are abundant. In appearance the rocks are fine-grained, dark gray, greenish, or black, but lighter-colored, coarser grained varieties occur as described below. They are commonly much weathered in surface outcrop, the majority of the dikes being concealed by soil. In weathering they disintegrate to a friable sand along joints and give rounded cobbles which shell off in concentric layers. The weathered rocks are commonly greenish to brown from the development of chlorite and limonite from the alteration of the ferromagnesian minerals. The effects of ordinary weathering do not extend any great distance downward, however, and the altered character of the dikes exposed in cuts and mine workings is from the development of sericite and other minerals indicating the action of thermal solutions.

In the field these rocks may readily be divided into two classes according to the character of the dominant ferromagnesian mineral. The rocks studied may with a few exceptions be called minette or spessartite. The hornblende rocks in the main have plagioclase as the dominant feldspar while most of those which show biotite as the predominant ferromagnesian mineral contain only alkalic feldspar. Kersantites, or lamprophyres composed of biotite and plagioclase, are rare, as is the hornblende-orthoclase rock, vogesite. The most abundant varieties are those consisting of greenish-brown hornblende and twinned lime-soda feldspar. These range from very fine-grained rocks to some which have the texture and appearance of fine-grained hornblende granite. A single specimen of the coarsest

forms might well be classed as a diorite, yet there is every gradation between the coarse forms on the one hand and very fine-grained mafic rocks of typical lamprophyric texture and mode of occurrence on the other. Such rocks to distinguish them from ordinary diorites must be called spessartites (although this name is objectionable, as it has been given also to a mineral of the garnet group). The relationship of the spessartites to the minettes is not clear. They are distinct from each other in composition—so much so in fact as to suggest that they were derived from the parent magma at slightly different periods. No data on the relative age relations of the two types were obtained in the field. There seems to be some evidence, however, showing that a given dike may pass from one rock into the other along its strike. Thus the large spessartite dike at Bailey's Pond apparently continues across the valley, yet on the north side of the river it consists of minette. The same thing occurs at Elk Creek where a typical minette is exposed on the south side of the valley yet where what seems to be the same dike reappears on the north side of the river, scarcely over a hundred yards distant, it is a much decomposed spessartite consisting almost entirely of hornblende with neither biotite nor orthoclase.

The lamprophyres are closely associated with the veins of the sections in which they occur. Around Kellogg almost every one of the large nonproductive pyritic quartz veins has its dike of lamprophyric rock within a few yards of the vein itself. Such relationships are well exhibited in the Lombardy, Teddy, Tillicum, Eldorado, Enterprise, Evolution, and other prospects near Kellogg and a similar relation exists in many of the lead mines of the Canyon Creek and Mullan areas as in the Hecla, Marsh, Moonlight, Morning, Rex, Helena-Frisco, Success, Standard, and other mines. This juxtaposition of dikes and veins argues in favor of the conclusion that they have a common source and also shows that at the time the lamprophyres were intruded, in contrast with the enormous abundance of later fissures, planes of weakness were few in number and igneous injections were constrained to occupy the same general channels followed by the mineralizing solutions.

DETAILED DESCRIPTION OF THE LAMPROPHYRES.

I. BIOTITE TYPE.

Minette, Hecla Mine.—The dike which occupies the same fissure, but is younger than the Hecla vein (see fig. 1), has been described by Ransome, as being chiefly composed of hornblende. Sections were not examined by the writer, and the first specimen which was studied was found on the Hecla dump and does not agree with Ransome's description. Specimens from various parts of the mine

in Mr. Umpleby's collection also fail to agree with Mr. Ransome's description as noted below, the only other rock known from the district which does agree with Mr. Ransome's specimen being the hornblende-quartz rock from Bailey's Pond.

In appearance this rock is essentially like that from the adjoining Marsh mine, being composed of biotite phenocrysts rather sparsely scattered through a rather light granular-looking gray groundmass.

Under the microscope this rock is seen to be composed of large phenocrysts of biotite with accessory iron ore and well-crystallized apatite with occasional much altered phenocrysts of diopside in a groundmass composed chiefly of alkalic feldspar. Among the secondary minerals may be mentioned abundant sericite formed at the expense of the feldspar, infiltrated calcite, and chlorite and secondary amphibole formed from the diopside. The biotite as usual in these rocks is intensely pleochroic in tones of dark and light brown with dark reaction rims and embayed outlines. It occurs in well-formed hexagonal tablets which are markedly parallel in arrangement and are fresh and unaltered.

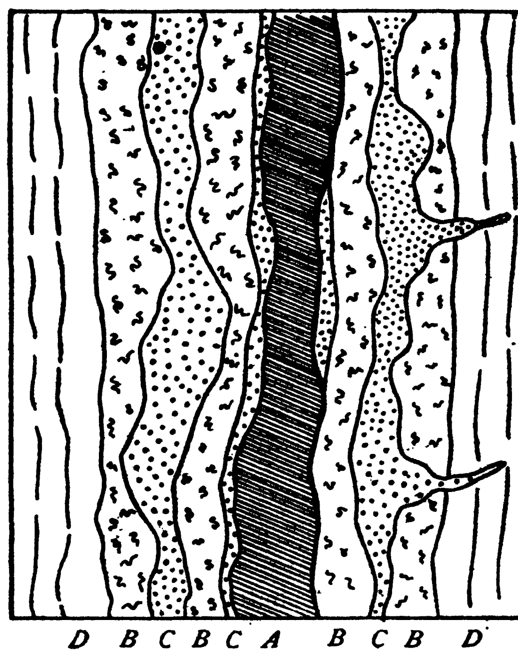


Fig. 1.—Diagram showing relation of dike to vein, Hecla Mine. A. Dike. B. Crushed material with quartz and ore. C. Galena. D. Quartzite wall rock. Width of section 15 feet.

The iron ore occurs in small scattered grains of euhedral outlines. The apatite, which is abundant and rather late in crystallization, forms well-crystallized stout hexagonal prisms. The groundmass appears to be, in large part, composed of orthoclase, which occurs in lathlike bundles of prismatic fibers which give a rather rolling extinction. This habit of the orthoclase gives the rock a somewhat trachytic texture. Between the orthoclase laths are interstitial areas filled with a material of very feeble birefringence which may be a zeolite or perhaps glass. Scattered throughout the groundmass are innumerable minute needles of granular appearance, high relief, high

birefringence, and approximately parallel extinction. These are too minute for their character to be determined, but they bear some resemblance to the minute rutile needles which make up the so-called sagenite nets. The diopside phenocrysts are rare and usually only small grains and patches of unaltered diopside occur, embedded in a mass of chloritic alteration products. The rock is a very typical minette.

A specimen from halfway between the two oreshoots on the 600-foot level is a holocrystalline very fine grained nonporphyritic aggregate of minute laths of feldspar and chlorite in shreds. The rock is greatly altered and now consists chiefly of chlorite. The original ferromagnesian mineral was clearly biotite although no vestige of unaltered biotite now remains. The feldspar grains, which are very minute, are untwinned and are probably orthoclase. The fabric is regularly dotted with grains of iron ore. Large patches of infiltrated calcite occur and inclusions of clear quartz are abundant. In some cases these inclusions are a single crystal individual but more frequently they are aggregates of interlocking grains, quite evidently fragments of quartzite. The quartz exhibits rolling extinction and other strain phenomena. These inclusions have no reaction rims.

Another specimen from the middle oreshoot on the 900-foot level is fine grained, holocrystalline, and fairly fresh. It contains numerous well-crystallized tablets of pleochroic brown biotite scattered through a ground composed almost entirely of alkalic feldspar having a trachytic texture from being composed of bundles of lath-shaped fibers sometimes curved and divergent and yielding rolling extinction. Iron ore in the usual small euhedrons is scattered throughout the fabric of the groundmass. Grains of augite exceeding the largest biotite phenocrysts in size occur at frequent intervals. These seem much shattered and irregular pieces seem to be detached portions of much larger individuals. They show well-defined cleavage but are much cracked and uralitization has progressed along cracks until now only grains of unaltered augite occur embedded in a mesh of alteration products. Occassionally one of these augites shows a sharp crystal boundary lined with grains of iron ore. In one place an inclusion of quartz—a single large rounded crystal individual—has a well-defined rim zone containing feathery crystallizations of magnetite. Infiltrated calcite is common.

A specimen from between the 1,400 and 1,600 foot levels is a moderately fine-grained rock consisting of biotite phenocrysts of the ordinary type in a ground of orthoclase which is now badly sericitized. Iron ore forms scattered grains and apatite is present in stout well-formed crystals. Calcite is very abundant and is in places intergrown with a green secondary mineral resembling chloropal. The section contains numerous inclusions of clear quartz having border

zones crowded with fern-like microlites of hornblende and iron ore. These inclusions are all somewhat rounded and embayed. (See pl. 39, B.)

Minette, Elk Creek.—In a railroad cutting just east of the mouth of Elk Creek is a narrow dike of biotite-lamprophyre, cutting rocks of the Prichard formation. On the south side of the cut, rounded residual lumps of fairly fresh rock remain, although decomposition has taken place along joints. On the north side of the cut the rock is decomposed to a friable sandy aggregate containing flakes of bleached and altered biotite. The dike is perhaps 4 feet wide at the bottom of the cut, but narrows upward to about 8 inches, near the surface.

In appearance this rock is exactly like the rock from the Hecla Mine, being composed of phenocrysts of biotite in a gray groundmass. Under the microscope the resemblance to the Hecla minette is still more marked, the Elk Creek rock consisting of numerous phenocrysts of biotite with accessory iron ore and well-crystallized apatite in a base of alkalic feldspar. Rarely, much-decomposed diopsides occur. Abundant secondary sericite has developed from the feldspar which is intensely altered. Areas of infiltrated calcite are common and some secondary quartz occurs.

That the composition given above does not make up the whole of the dike at Elk Creek is evident upon examination of a specimen collected here by Mr. Calkins. Although labeled the same and of the same appearance in the hand specimen Mr. Calkins' specimen is markedly different as seen in thin section under the microscope. Here, although the sparsely disseminated biotite phenocrysts are large and conspicuous they make but a small fraction of the whole volume of the rock which is composed of a fine grained holocrystalline aggregate of feldspar and hornblende which is of the usual type. The feldspar is so poorly individualized and so greatly altered that little can be said regarding it other than that it is chiefly orthoclase. Less abundant grains are zoned though not twinned and are probably plagioclase. This abrupt variation may represent an inclusion or a transition toward the spessartite which occurs in the line of strike on the north side of the river. Similar abrupt differences between different parts of the same dike are described elsewhere. Mr. Calkins' specimens may be described as a porphyritic biotite vogesite. (See pl. 38, A.)

Augite-Minette, Marsh Mine.—In the upper levels of the Marsh Mine at Burke, two small dikes are exposed. On the No. 1 tunnel level there is exposed one very much decomposed dike, about 6 inches wide, which consists of much bleached and altered biotite phenocrysts in a pasty or sandy brownish-green matrix. This dike, somewhat wider and less decomposed, is crossed by the raise between the

No. 1 and No. 2 tunnels, and on the level of the No. 2 tunnel it is quite fresh, has a width of about 2 feet, and cuts cleanly across the vein on this level and the level below. On the No. 1 level below the tunnel one dike cuts cleanly across the vein, while the other is deflected along the vein for some feet and dies out. (See fig. 2.) Below this level these two unite to form a single dike, which gradually widens with depth. Two specimens studied came from the old sheaveway above the inclined shaft, on the level of the No. 2 tunnel. One specimen was taken from the center of the dike and the other from the contact with the inclosing slaty rocks of the Burke formation.

In the hand specimen the rock from the Marsh dikes is dark gray in color and porphyritic from the development of numerous bright brownish-black phenocrysts of biotite in an almost aphanitic gray groundmass. The individual phenocrysts of biotite average about 2 mm. in diameter and are not well crystallized. No other minerals can be distinguished with the unaided eye. The rock is quite fresh, but where altered it assumes a brownish color and becomes friable, the groundmass being completely altered before

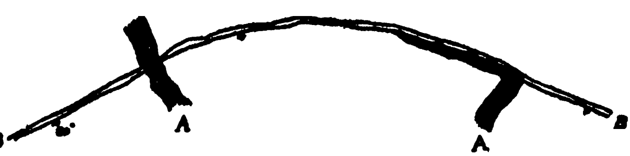


FIG. 2.—SHOWING RELATION OF DIKES (A) TO VEIN (B) ON NO. 1 LEVEL OF MARSH MINE.

the biotites are attacked. The dikes are cut by numerous joints which appear to follow no regular system. The rock has a rather marked tendency to cleave parallel to the walls of the dike, due to a flow structural arrangement of the biotite phenocrysts. The material from the border of the dike is finer grained; the biotites are slightly smaller, averaging about 1 mm. in diameter, are somewhat better crystallized, and are more markedly arranged parallel to the walls, thus emphasizing the cleavage of the rock.

Under the microscope the rock is seen to consist essentially of biotite and augite, with accessory apatite and iron ore in an unindividualized glassy base. Among the secondary minerals may be mentioned abundant sericite which has developed in the ground mass and also probably opal, tridymite, and some zeolites which have developed in the augite. The biotite is of the type characteristic of lamprophyres, with intense pleochroism in tones of dark and light brown, deep embayments, and dark colored resorption rims. It is usually entirely fresh and the phenocrysts are remarkably free from inclusions. The augite, which equals or exceeds biotite in amount, occurs in large phenocrysts with rather poor crystal outlines which

are commonly merely spongy shells inclosing a large amount of the material of very low refraction and double refraction which may include opal, tridymite, and zeolites. The augites which are near diopside in composition, are commonly colorless but frequently have a narrow, faintly pleochroic border of a pale green color which shows some admixture of the aegirite molecule. There are clearly two generations of the colored constituents of the rock. The apatites, which are often of large size, are late in crystallization and often contain dust-like inclusions, especially along the vertical axis. The iron ore occurs in abundant small euhedral grains in the groundmass. The flow structure of the rock is very marked. The groundmass is mostly colorless to brownish glass but in places it acts feebly on polarized light. The rock from the border of the dike has smaller biotites and the augites are even more spongy than in the main mass of the dike and the groundmass is more completely glassy. This glassy groundmass contains much dust-like material which by its dispersion gives the glass a brownish color suggesting kaolin.

Since classifications are based upon the character of the feldspar, and there is no feldspar present in uncrystallized base of this rock, it is difficult to say whether the rock should be classed with the minettes or the kersantites. The aegiritic rims of the augites and the faintly double-refracting patches in the groundmass give the rock an alkalic appearance in thin sections and it is placed with the majority of biotitic lamprophyres studied in the minette class. In consideration of the abundant presence of augite the rock may be termed an augite-minette.

Minette, Senator Stewart Mine, Kellogg.—A specimen of very dense lamprophyric rock from the Senator Stewart mine, in Deadwood Gulch, near Kellogg, is intensely altered as seen in thin section and only the original texture is preserved in the secondary minerals. Apparently it was much like the glassy minette from the Marsh Mine. It shows the usual fabric of biotite laths in what appears to have originally been an alkalic glass, but which is now deep green in color, and almost opaque. It is dotted with small grains of iron ore. Large scattered fragments of broken and irregular outline are now quartz, but appear to have originally been augites.

Olivine-augite-minette, Kellogg.—On the north side of the river, on the Kellogg-Wallace road, just east of Kellogg, there are exposed a number of small lamprophyre dikes. These are directly across the valley from the Bailey's Pond locality described below, and in the field were supposed to represent the continuation of the same dikes. Microscopic study of the largest and freshest dike at this locality, however, shows the mineralogic composition to be entirely unlike anything exposed on the south side of the river. There are at

least four dikes exposed here, cutting quartzitic rocks of the Prichard formation, three of which are about 4 feet in average width. These three dikes, while completely decomposed, resemble the dark spessartites of the Bailey's Pond side. The fourth, which is the westernmost, is somewhat fresher in appearance. At the level of the road it is about 8 feet wide, but it narrows upward. On the surface it is traceable for about one-fourth of a mile in a northwesterly direction, and may connect with dikes in Italian Gulch, which are in the line of strike.

In the hand specimen this rock is fine-grained and of a greenish-gray color. The most abundant megascopically distinguishable mineral is micaceous and of a greenish color. Small white grains, presumably feldspar, are visible under a lens. The rock is tenacious but has a tendency to cleave parallel to the walls of the dike.

Under the microscope the rock is equigranular except for rare phenocrysts now consisting entirely of serpentine which is clearly secondary after olivine. The other original minerals are colorless augite, biotite, and orthoclase with accessory iron ore and apatite. The rock is very much altered. Among the secondary minerals the most abundant is chlorite, which has developed at the expense of the original biotite. Calcite in infiltrated patches and secondary quartz are abundant. Epidote occurs in places as an alteration product of biotite and sericite is common in the feldspar. The olivine phenocrysts are now represented by masses of serpentine, dotted with iron ore which are commonly surrounded by a rim of biotite and augite.

The pyroxene, which is colorless and unaltered in thin section, is near diopside in composition, and is perhaps the most abundant mineral of the rock. It forms prismatic individuals with poorly developed form and barely perceptible cleavage. Biotite occurs in thin laths and tablets, pleochroic in tones of dark and light brown. There now remain only ragged remnants of the original biotite surrounded by chlorite. The orthoclase, which is greatly sericitized, forms poorly individualized interlocking grains. Iron ore is abundant in small grains and apatite occurs in the usual prismatic crystals. Quartz is abundant in the interstices, but it is all clearly secondary. The rock thus has no features in common with the spessartite of the Bailey's Pond side.

Augite Minette, Murray Hill.—Another rock, collected by Doctor Umpleby and examined only in thin section. Contains an unusual number of sharp euhedral crystals of augite in a groundmass composed of biotite and orthoclase. The augite is for the most part clear and colorless but the crystals have at times a narrow faintly pleochroic pale-green border of aegirite-augite. The orthoclase is of the peculiar type composed of bundles of prismatic fibers. It is

somewhat sericitized. Interstitial quartz grains which occur frequently may be secondary. (See pl. 37A.)

Lamprophyre, Grouse Tunnel, Grouse Gulch.—This rock is megascopically one of the coarsest of the lamprophyres. It is of medium-gray color, having feldspar in excess of ferromagnesian minerals, and has prominent black spots which apparently are small aggregates of hornblende. Under the microscope it appears as a comparatively coarse holocrystalline aggregate of feldspar with slightly subordinate ferromagnesian minerals consisting of hornblende and biotite in about equal amounts. The feldspar consists of both orthoclase and plagioclase, the former slightly in excess.

Olivine-Kersantite, Spring Gulch.—Just west of the mouth of Spring Gulch on the south side of the river near Osburn, two parallel dikes are exposed a few feet apart, cutting rocks of the Prichard formation. These dikes were examined by the writer, but in the following description Mr. Calkins' specimens and sections were utilized. Only the largest and freshest dike is represented. In the hand specimen the rock is dark gray to black, fine grained and non-porphyritic, showing under a lens small flakes of biotite and brown spots which may represent serpentinized olivines. Under the microscope it shows the usual trachytic aggregate of plagioclase laths with predominant biotite and accessory hornblende as the ferromagnesian minerals. The plagioclase is in well-defined laths, characteristically zoned and twinned. Sericitization is well advanced in all cases, beginning with the more basic cores of the crystals and progressing outward. Augite is common in disseminated ragged crystals and large pseudomorphic areas of both talc and serpentine, dotted with iron ore, which are in this case surrounded by a rim of biotite, clearly represent original olivine. The usual accessory apatite and iron ore are present.

Minettes, other occurrences.—Other much decomposed biotite-lamprophyre dikes occur in the district, especially near the Enterprise Prospect, near the mouth of Polaris Gulch, and near Raven, on Prichard Creek. A typical fresh rock of this type is exposed in the workings of the Moonlight claim above Burke, but it was not studied in thin section.

II. HORNBLENDE TYPE.

Odinite, Hecla Mine.—Ransome[1] describes the dike which accompanies the Hecla Vein as occupying the same fissure as the lode and having an average width of two feet but in places reaching 7 feet. It is not quite simple, but branches and pinches out to be succeeded by another dike a few feet to one side. The dike is clearly younger than the ores and sends out minute branches which occupy little fissures

[1] Prof. Paper, U. S. Geol. Survey, No. 62, p. 176.

in the ores, and is more glassy at the borders than in the center. The ores are not noticeably metamorphosed.

In its freshest condition the rock of this dike is dark greenish-gray and fine grained, the only minerals recognizable to the unaided eye being small prisms of hornblende, specks of pyrite, and scattered grains or granular inclusions of quartz up to an inch in diameter. The microscope shows a holocrystalline aggregate of abundant phenocrysts of hornblende in a groundmass of the same mineral, with a calcic-plagioclase in minute laths. Larger phenocrysts, possibly augite, have been completely altered to calcite, serpentine, and secondary amphibole. The rock appears originally to have had some glass in the groundmass, but it is now altered to chlorite. The quartz inclusions are much corroded and embayed and are usually surrounded by reaction rims in which spherulitic quartz appears in the groundmass. The rock is probably an odinite, hornblende being too abundant for kersantite, in which biotite is the principal dark mineral. The quartz grains are presumably not original but are inclusions derived from the quartzose sediments through which the dike was intruded.

No other rocks of this character have been seen from this mine. This suggests that the Hecla dike may not be as simple as is generally supposed and lamprophyric magmas of two types may have been injected into the fissure at slightly different periods.

Hornblende-quartz rock, Bailey's Pond.—At the side of the old road, at Bailey's Pond, south of the river, a short distance east of Kellogg, there are several lamprophyric dikes. Four or five narrow black dikes averaging each about 2 feet in thickness outcrop almost horizontally, one above another, along the face of the cliff. These are almost aphanitic in texture and are very much altered but appear to have originally been spessartites. In weathering they characteristically give rounded cobbles resembling water worn bowlders. The uppermost dike appears originally to have been somewhat larger than the others but here there are clearly two dikes intruded into the same fissure. The dark mafic rock is in places shattered, forming a breccia cemented by the later much more feldspathic rock. In other places the later intrusion has followed the bottom contact or the top contact or sometimes both giving a central layer of the dark rock sandwiched between two layers of the more feldspathic rock the contact in all places being clean-cut with no mingling of the two materials. The dark rock of this dike in the hand specimen looks fresher and more completely crystalline than that of the dikes below. It is a fine-grained equigranular rock of dark greenish-gray color, which to the unaided eye shows numerous glittering prisms of black hornblende. Megascopically it is indistinguishable from the typical fresh spessartites of the Standard and other dikes.

Under the microscope this rock is seen to consist almost entirely of hornblende and quartz, feldspar being entirely absent. Biotite forms ragged and much resorbed phenocrysts now almost entirely altered to chlorite. The biotite differs from the ordinary biotite of the

lamprophyres of this region in that in color it ranges from pale greenish-brown to deep brownish-green. The quartz forms interlocking grains which are relatively free from inclusions. Small well crystallized apatites are sparingly scattered through the rock and occasional large phenocrysts of diopside occur surrounded by hornblende in parallel position. Iron ore seems to be absent. Among the secondary minerals, the most important is chlorite, formed at the expense of both the biotite and hornblende. Areas of infiltrated calcite, small masses of epidote and abundant ragged grains of pyrite make up the list.

The hornblende is very pleochroic in tones of greenish brown. The prisms of hornblende which are in part well bounded by crystal planes show well-developed cleavage and are very frequently twinned parallel to (100). The extinction angle, measured from the twinning plane, is near 16°. This brownish hornblende is apparently a variety intermediate between common and basaltic hornblende very near the latter as in the other spessartites described below. In this rock, however, cores of brown hornblende are frequently surrounded by an outer fringe of common green hornblende in parallel position.

This quartz-hornblende rock is very unusual in composition and its mode of occurrence would suggest that the unusual composition might be due to alteration of a contact-metamorphic nature incident upon the intrusion of the later more feldspathic rock into the same fissure. Opposed to this hypothesis, however, is the fact that the altered rock equals in amount the later rock, which might have caused the alteration. Furthermore, where these magmas are in contact with the inclosing sediments, they have nowhere exerted any noticeable metamorphic influence. The rock from the Hecla Mine described by Ransome as consisting chiefly of hornblende with a large amount of included quartz gives a reasonable explanation of the pecularity of the Bailey's Pond quartz-hornblende rock. In all probability it is the same as the "odinite" of the Hecla dike—a magma consisting entirely of ferromagnesian minerals which derived and absorbed a large amount of silica from the quartzitic rocks through which it was intruded. This derived quartz became thoroughly diffused and recrystallized as a part of the fabric of the rock instead of remaining as recognizable inclusions as in the Hecla dike.

Bailey's Pond, Spessartite.—The rock which is intruded into the same fissure forming a mixed dike with the one described above varies greatly from place to place in texture and appearance. Perhaps the most abundant type is medium-grained equigranular and of a dark gray color but showing, under a lens, a "pepper-and-salt" aggregate of glittering black hornblende prisms and grains of feldspar. In other parts of the dike this rock is porphyritic from the development of numerous phenocrysts of white feldspar averaging

3 mm. in diameter. From the rather basic form described the rock varies to types which are almost white and consist of scattered prisms of hornblende in a feldspathic base. In places near the lower contact there is a very marked lamination, the rock consisting of layers of feldspathic material alternating with layers composed almost entirely of prismatic hornblende. This may be due to flow structure, segregated bunches of mafic minerals having been drawn out into lines. The fact that this lamination is represented only at the bottom contact where the dike is almost horizontal makes it interesting to consider the possibility that these alternating laminae may be due to crops of crystals of ferromagnesian and of feldspathic minerals separating alternately from the mass of the dike and sinking through the still fluid magma to the bottom. The most acid phase of the rock is somewhat pegmatitic in character and clearly represents an acid residuum which concentrated in patches as the last material to crystallize.

Under the microscope the main mass of the dike is seen to consist of a beautifully trachytic aggregate of laths of plagioclase and prisms of greenish-brown hornblende. Small shreds of pleochroic brown biotite are now almost entirely altered to chlorite. The feldspar, which is the most abundant mineral, is a plagioclase which occurs in beautiful laths characterized by the rarity of twinning on the albite law, the majority of the crystals being simply twinned once. In the main mass of the rock the feldspars are all beautifully zoned and range in composition from basic bytownite, Ab_{16} An_{84}, at the center to acid andesine, Ab_{70} An_{30}, at the peripheries. Where the rock contains porphyritic phenocrysts of feldspar, these are usually even more basic than in the main mass of the rock, ranging down to pure anorthite in the center. These beautifully zoned phenocrysts frequently show carlsbad, albite, and pericline twinning in the same individual. Occasionally there are inclusions of quartz which reach 3 mm. in diameter, each inclusion being a single crystal individual. These are commonly surrounded by rims of hornblende and frequently have a small patch of chlorite in the center. The quartz contains lines of fluid inclusions. The hornblende is in prisms which are somewhat ragged and frayed at the ends but which, in cross sections, are sharply euhedral. The hornblende is frequently twinned parallel to (100). It is a basaltic variety, pleochroic in pale to dark greenish brown. In the coarsest-grained acid phase of the rock the minerals present are the same as in the main mass of the dike—plagioclase, hornblende, and some biotite. The hornblende is pale to dark brown, lacking the greenish tinge of the finer-grained rock. The biotite, which is much altered to chlorite, is also pleochroic in brown tones. It is present only in rare shreds. The feldspar, which is greatly kaolinized, is not so basic as in the

main mass of the rock. The feldspar phenocrysts are zoned and show albite and carlsbad twinning. They range in composition from oligoclase-albite, Ab_{92} An_8, at the peripheries to bytownite-anorthite, Ab_{17} An_{83}, at the cores. Quartz and micropegmatite are common in the interstices of this rock.

Spessartite, Eldorado claim.—At the portal of the tunnel of the Eldorado claim, a prospect opening on a small barren vein in the Prichard formation on the north side of the river, about a mile east of Kellogg, a small amount of quarrying has been done on a broad exposure of lamprophyric rock. This may be in the form of a neck or stock as it can not be traced in any direction from this exposure. There is some evidence that narrower dikes of ordinary more basic lamprophyre may radiate outward from this mass and the quartz-pyrite vein developed in the tunnel terminates at the igneous rock in a suggestive manner. In the hand specimen the rock is fairly coarse granular and consists of equal parts of white to pale flesh colored feldspar and greenish hornblende. Occasional large poikilitic biotites occur and small veinlets of pegmatitic material were seen. Under the microscope the rock is a coarse aggregate of hornblende and feldspar. The larger feldspars which are badly sericitized internally are plagioclase. Smaller grains appear to be orthoclase. The hornblende is of the usual type. Large chlorite patches dotted with iron ore and surrounded by hornblende rims appear to represent original augite. Dots of iron ore and a few long prismatic apatites occur. (See pl. 38 B.)

Spessartite, Lombardy claim.—The first 70 feet from the portal of the lower tunnel of the Lombardy claim in Italian Gulch north of Kellogg are in a peculiarly equidimensional mass of lamprophyric rock precisely like that last described on the Eldorado claim. There is evidence that one or more dikes of finer grain and more mafic composition may extend outward from this mass. The Lombardy vein, carrying some lead and great masses of cupriferous pyrite and pyrrhotite, also extends outward from this igneous mass. Megascopically the rock of this occurrence is indistinguishable from that of the Eldorado claim and the microscopic character is similar. The feldspar, which is much altered, appears to be a rather basic plagioclase. The hornblendes which are sharply euhedral show some incipient alteration to green chlorite but are for the most part fresh with well-developed cleavage. They are as usual pleochroic in tones of light to dark greenish brown but have borders of green hornblende. The rock contains large areas of calcite. Associated with these are patches of serpentine with hornblende rims which are probably altered olivines. Biotite occurs rarely and in the form of small tablets. Scattered stout well-formed prisms of apatite and grains of iron ore occur. Quartz is absent.

Other coarse spessartites.—Certain dikes which accompany the Osburn fault throughout a large part of its length closely resemble these coarse spessartites, but they are enormously decomposed.

Spessartites, Standard Dike.—One of the most interesting rocks studied was that which intersects the Standard vein in the Greenhill-Cleveland Mine, near the center of the Standard-Mammoth ore shoot. Specimens were collected from this dike on the 1,200-foot and 2,000-foot levels of the mine. On the 2,000-foot level the dike cuts squarely across the ore body, bulging slightly in the vein. On the 1,200-foot level the dike is deflected along the vein for about 20 feet. These relations are shown in figures 3 and 4. This dike coincides in dip with the pitch of the ore shoot and it can be traced upward to the No. 5 tunnel, 2,500 feet vertically, above the 2,000-foot level.

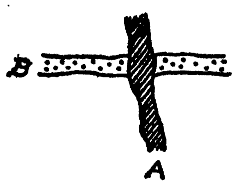


FIG. 3.—SHOWING RELATION OF DIKE (A) TO VEIN (B) ON 2,000 FOOT LEVEL OF STANDARD-MAMMOTH MINE.

In the hand specimen this is a dark-gray equigranular fine-grained rock, showing minute needles of hornblende and white grains of feldspar under a good lens. That from the deep levels of the mine is quite fresh, but material from the No. 5 tunnel is altered to a friable sandy brownish-green aggregate. The fresh rock is cut by numerous joints which divide it into sharp-edged rhombic or tetrahedral blocks.

Under the microscope the rock is seen to be composed of prisms of pleochroic greenish-brown hornblende with accessory and not very abundant iron ore in small scattered grains, occasional small apatites, and minute shreds of biotite in a beautifully crystallized trachytic groundmass composed of twinned laths of plagioclase. In the rock from the 1,200-foot level there also occur occasional large phenocrysts, which were apparently originally olivine but which are now entirely altered to talc. These are commonly surrounded by a rim of hornblende prisms. They do not occur in the rock from the 2,000-foot level. The hornblende, which is well crystallized, is intensely pleochroic in tones of deep brownish-green and pale greenish-brown. It is frequently twinned parallel to (100). The extinction angle measured from the twinning plane is around 12 degrees. This is near basaltic hornblende grading toward common hornblende. The plagioclase shows broad twinning lamellae and ranges in composition from anorthite, Ab_5An_{95} at the center to labradorite, Ab_1An_1, at the peripheries. There is a gradual shading from center to border with no distinct zones. The rock from the 1,200-foot level may well be called an olivine-spessartite in view of the original occurrence of olivine. The rock from the 2,000-foot level is a typical spessartite.

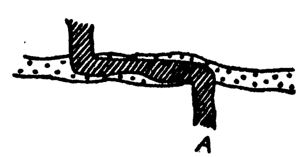


FIG. 4.—SHOWING RELATION OF DIKE (A) TO VEIN (B) ON 1,200 FOOT LEVEL, OF STANDARD-MAMMOTH MINE.

Peculiar interest attaches to a rock which forms a very small branch from the Standard dike into the quartzite of the footwall on the 1,200-foot level of this mine. In the hand specimen the rock is seen to consist of small, greenish grains in an aphanitic black base, the whole looking like an ordinary basalt. It is clearly a result of sudden cooling on the magma which composes the larger dike.

In thin section the rock is seen to have originally consisted of abundant large well-crystallized phenocrysts of olivine and smaller prisms of augite, in a matrix consisting of glass completely filled with minute prismoid laths of augite. Scattered rather large grains of iron ore also occur. The olivine is now entirely changed to aggregates of fibrous talc, no vestige of the original substance remaining. The original cracks, typical of olivine, are now preserved by dotted lines of iron ore. The augite phenocrysts are almost as completely altered to chlorite with some secondary silica. Some of the original pyroxene still unaltered was identified as near diopside by its extinction angle. Many of the large olivines have been shattered and the parts slightly separated from each other, the intervening space being filled by the material of the groundmass. The minute lath-like microlites of augite were identified by their rather high index of refraction, moderately high birefringence, extinction, and square cross section. They show none of the alteration which marks the large augite phenocrysts.

This rock apparently indicates that the magma, which upon crystallization in the larger dike gave a typical spessartite, when intruded contained abundant crystals of olivine and augite. With slow cooling these phenocrysts, by reaction with the magma, were changed to hornblende as evidenced by the talcoid pseudomorphs surrounded by hornblende rims in the main dike on the 1,200-foot level. On the 2,000-foot level at some 800 feet greater depth, where cooling presumably was slower, the olivines were more completely resorbed and no vestige of them now remains. Whether this change is due to absorption of silica from the walls of the fissure by the magma in its upward progress is not clear, but it forms an interesting hypothesis.

Spessartite, Reeder Gulch.—This rock, one of the few of those described which came from the Murray region, forms a very long dike exposed in the mouth of Reeder Gulch by the side of the Golden Chest mill. Megascopically it is a very light-colored rock of nonvitreous chalky appearance and fine grain, but with widely spaced phenocrysts of very black biotite. Under the microscope it exhibits two materials of very different texture but of the same mineralogical composition. The contact between these is sharp, one being fine and the other coarse grained, and both consisting of hornblende prisms and laths of plagioclase. The coarser portion contains large aggregates of radiating prismatic epidote, especially

along the contact with the finer-grained phase which is free from epidote. This is one of the types of agglomeratic intrusion referred to elsewhere. (See pl. 39 A.)

Spessartite, Rex Mine Ninemile.—A specimen collected by Doctor Umpleby and examined only in thin section, shows a holocrystalline fine-grained nonporphyritic lamprophyre, consisting in large part of prismatic hornblende, with less abundant plagioclase. The hornblende is not so well crystallized as is usual in these rocks. The plagioclase is zoned, but twinning is rare. The rock contains frequent patches of serpentine suggestive of original olivine, in each case surrounded by a rim of hornblende. The rock is very similar to that of the Standard dike.

Olivine-augite vogesite, Frisco Mine.—This rock, which cuts sharply across the ore body on the 1,600-foot level of the Frisco mine west of the shaft, is seen under the microscope to be composed of large phenocrysts of augite, rather sparsely scattered through a fine grained holocrystalline groundmass consisting of the usual green-brown hornblende and feldspar. The augites are perfectly fresh and show well-developed cleavage. Occasionally there is a suggestion of very pale green color and barely perceptible pleochroism indicating some admixture of the aegirite molecule. The feldspar is in such minute and poorly characterized altered individuals that its character must remain in doubt. While the appearance resembles twinning it is probable that it is orthoclase of the fibrous character noted elsewhere—an assumption supported by the alkalic appearance of the augites. Sparsely disseminated large phenocrysts now consisting entirely of talc dotted with iron ore are surrounded by hornblende and represent original olivine. (See pl. 37B.)

Vogesite, lower part of R. R., E. Fork of Ninemile Creek.—This rock, which was collected by Calkins, is a good example of the agglomerate or mixed dike so common among these rocks. In the hand specimen it is quite plainly made up of two kinds of rock, one a rather coarse granular aggregate of hornblende and feldspar forming inclusions in a matrix of darker colored material composed of hornblende prisms in an indeterminate grayish base. The thin section which evidently was cut from the latter portion of the specimen shows phenocrysts of hornblende of the usual type in a very fine grained ground apparently consisting of minute grains of orthoclase. Large patches of chlorite surrounded by rims of hornblende suggest original augite. Quartz in interstitial grains is common. Iron ore in scattered grains is the only other prominent accessory.

Other lamprophyric dikes.—The lamprophyric dikes are present over the whole of the Coeur d'Alene district and surrounding territory. There is scarcely anywhere an artificial exposure of Prichard formation rocks which does not contain one or more of the dikes and

to describe each one separately is impossible. The above descriptions, it is believed, cover the main types. The present paper is intended as a more or less purely petrographic contribution which is prepared to pave the way for a discussion of certain evidence regarding the problems of ore genesis and modes of vein formation which, it is hoped, may be published later. The portion of the conclusions of the present work which applies to the problem of vein formation may be summarized as follows:

1. Lamprophyric dikes in such widespread occurrence substantiate the conclusion that the district is underlain by a granitic batholith.

2. The fact that complementary aplite dikes failed to reach the position of the present erosion surface gives some evidence as to the depth at which this mass must lie.

3. The coincidence in position of dikes and veins indicates a common source and argues a paucity of planes of weakness at the time of their formation.

4. The dikes are later in all observed cases than the veins with which they are associated, yet they are all more or less affected by a hydrothermal alteration which is traceable to the dying stages of vein-forming activity proving that the dikes and veins belong substantially to the same general period.

EXPLANATION OF PLATES.

Plate 37.

A. Augite-Minette, Murray Hill. Abundant phenocrysts of biotite with scattered larger augites in a groundmass of orthoclase. Ordinary light. Magnified 30 diameters.

B. Olivine-augite vogesite, Helena-Frisco mine. Shows areas of talc, pseudomorphous after olivine dotted with iron ore and surrounded with reaction rims of hornblende together with large crystals of augite in a groundmass of hornblende and orthoclase. Ordinary light. Magnified 30 diameters.

Plate 38.

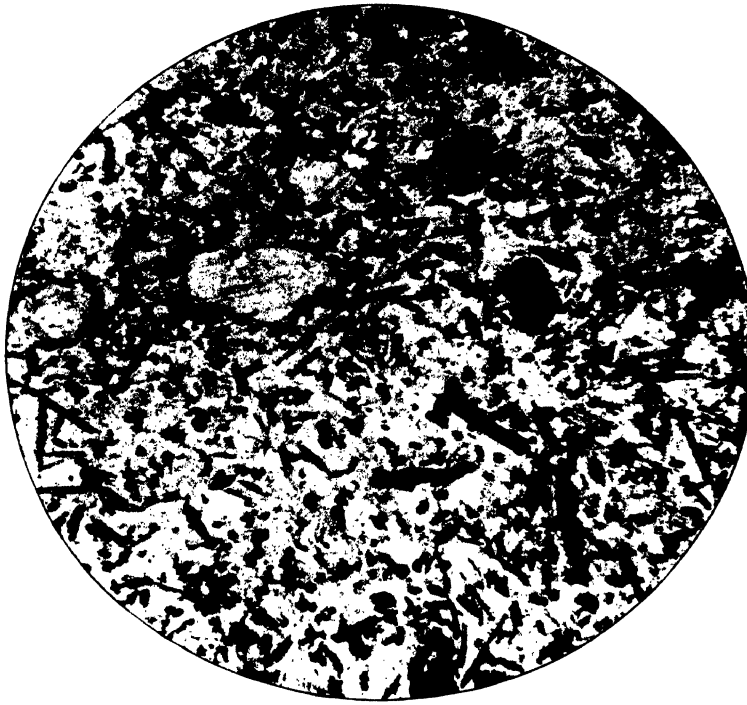
A. Porphyritic biotite vogesite. Variant of Elk Creek dike. Large biotite phenocryst in a mass composed of hornblende and orthoclase. The large clear areas showing well-defined cleavage are calcite of obscure origin. Ordinary light. Magnified 30 diameters.

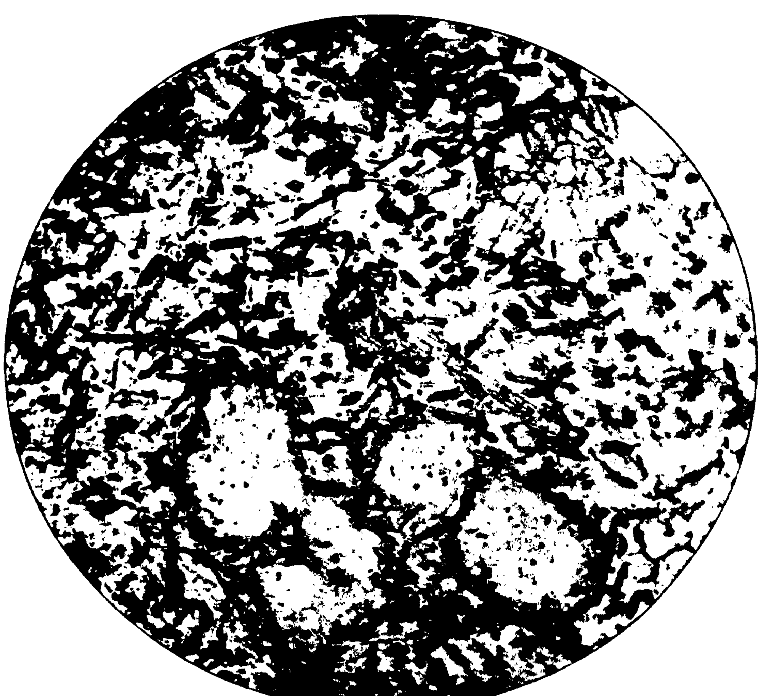
B. Spessartite, Eldorado Claim. Very coarse aggregate of prismatic hornblende and feldspar. White patches are holes in section. Ordinary light. Magnified 30 diameters.

Plate 39.

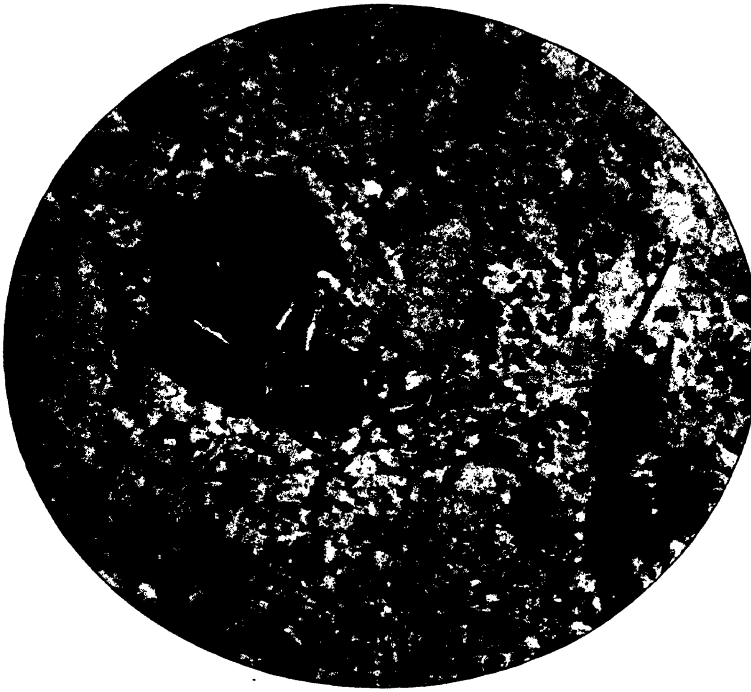
A. Spessartite, Reeder Gulch. Showing contact of coarse and fine grained aggregates of hornblende and feldspar with large area of radiated epidote. Ordinary light. Magnified 30 diameters.

B. Minette, Hecla Mine. Shows inclusion of quartz surrounded by a reaction rim in an aggregate of biotite and orthoclase. Ordinary light. Magnified 30 diameters.





AUGITE-MINETTE AND OLIVINE-AUGITE VOGESITE.



PORPHYRITIC BIOTITE VOGESITE AND SPESSARTITE.

FOR EXPLANATION OF PLATE SEE PAGE 495.

SPESSARTITE AND MINETTE.

A NEW CHINESE ISOPOD, ICHTHYOXENUS GEEI.

By Pearl L. Boone,
Aid, Division of Marine Invertebrates, United States National Museum.

The species herein described was found parasitic on the "Tsi-fish" or carp, probably *Cyprinus carpio* taken from lakes and canals around Soochow, China, by Prof. N. Gist Gee, of Soochow University, whose energetic investigations are constantly increasing our knowledge of this hitherto neglected region.

This is the fourth representative of the genus *Ichthyoxenus*, a group whose mode of life is peculiarly interesting. When young, the isopod bores a hole in the body of a fish, just behind the lateral fin, where it lives with its mate, developing so in size that it is impossible for it to escape through the opening by which it entered.

The type species of the genus, *Ichthyoxenus jellinghausii* Herklots,[1] described in 1870, was found parasitic on the fish *Barbodes maculatus* Bleeker from Java, and in 1908 another host for this species was reported by Maj. P. A. Ouwens,[2] namely, the fish *Nemacheilus fasciatus* van Hasselt from the Tji-Seroema near Batavia.

Ichthyoxenus montanus Schioedte and Meinert,[3] the second representative of the genus, was described in 1884 as parasitic on *Puntius sophores* in the Himalayan Mountains.

In 1913 Richardson described the third species of the genus, *Ichthyoxenus japonensis*,[4] from the following hosts: *Acheilognathus rhombeum* (Schlegel), *Gnathopogon elongata* (Schlegel), *Acheilgnathus tabira* Jordan and Thompson, *A. lanceolatum* (Schlegel), *A. cyanostigma* (Jordan and Fowler), and *A. limbatum* Jordan and Snyder, from Lake Biwa, Japan.

Family CYMOTHOIDAE.

Genus ICHTHYOXENUS Herklots, 1870.

ICHTHYOXENUS GEEI, new species.

Plates 40 and 41.

Female.—Body subovate, strongly convex, about 23.1 mm. long, greatest width about 11.7 mm. Surface smooth; color (preserved

[1] Archives Neerlandaises des Sciences, vol. 5, 1870, pp. 128–137, pl. 5, figs. 10–18.
[2] Natuurk. Tijdschr. Nederl.-Indie, vol. 67, 1908, pp. 29–35.
[3] Naturk, Tidsskrift Kjobenhavn, ser. 3, vol. 14, 1884, pp. 303–309, pl. 11, figs. 10–17.
[4] Proc. U. S. Nat. Mus., vol. 45, No. 1995, pp. 559–562, text-figs. 1–6.

specimens) creamy yellowish with minute black dots sparsely scattered on the body and more densely so on the dorsal surface of the head. Irregular carinations on the various segments give the dorsal surface of the body a rugged aspect.

Head small, and subtriangulate, convex, 3.1 mm. long, 3.5 mm. wide, frontal margins slightly rounded and posterior margin strongly rounded. Eyes shining black, subovate, moderately large, 1 mm. long, placed obliquely in the anterolateral angles of the head, and separated from each other at their nearest point by a distance of 2 mm., being distinctly more elongate and different in contour from the eyes of *I. japonensis*. First antennae short, consisting of 8 articles and extending slightly beyond the anterior end of the eye. The second antenna consists of 10 articles and extends quite to the posterior margin of the head.

A comparative diagnosis of the maxillipeds of the present species and its closest ally, *I. japonensis* Richardson,[1] seems desirable, especially since the author made no mention of the mouth parts in her discussion of *japonensis*. In *geei* the maxilliped is relatively quite short, its distal margin having the upper two-thirds of both lobes of the first maxilla entirely exposed while in *japonensis* the space between the anterior lip and the tip of the palp of the maxilliped is quite small and the outer margin of the masticatory lobe is produced beyond the margin of the epistome and the respective margins along the incision bilobating the lower lateral region are greatly roundly produced and overlap. Thus in *japonensis* the maxilliped covers the entire underlying mouth parts except the very tips of the maxillae, which are barely visible, and the distal ends of the palp, which meet above the epistome. In *geei* the maxillipeds are much broader in the basal region, with the bilobation of the masticatory lobe which occurs in the upper outer median lateral area marked by a distinct excavation, and the upper part of the lobe is not greatly produced, the inner area being relatively truncate. The palp is well developed and extends quite beyond the anterior margin of the masticatory lobe. The distal joint of the palp is well developed in marked contrast to that of *japonensis*, which is rudimentary, almost obsolete. The entire palp of *japonensis* is relatively small and overshadowed by the produced masticatory lobe.

Thorax roundly ovate, strongly convex, moderately asymmetrical. First segment 3 mm. long in median line, 9 mm. wide, with anterior margin deeply roundly excavate surrounding the posterior margin of the head. The lateral margins have the anterior half produced anterolaterally beyond the angles of the head and the posterior half directed almost straight back; the posterior margin is also relatively a straight

[1] *Ichthyoxenus japonensis* Richardson, Proc. U. S. Nat. Mus., vol. 45, No. 1995, vol. 45, pp. 561–562, text figs. 4–6.

line, in striking contrast to that of *japonensis*, which is recurvate. The entire segment is distinctly narrower than the second segment, extending only to the inner margin of the latter's epimera. The second, third, and fourth segments are similar and subequal, differing only in that their lateral parts graduatingly increase posteriorly and their respective epimera correspondingly graduatingly decrease posteriorly. The fifth, sixth, and seventh segments are similar, each being about two-thirds the length of the preceding segment; all are decidedly constricted postlaterally. Epimera are present on the last six segments; all are roughly triangulate. Those of the second, third, and fourth segments are relatively large, occupying the anterolateral angle of the margin of their respective segments and being closely appressed. The epimera of the fifth, sixth, and seventh segments are proportionately weaker and are almost hidden by the overlapping of the respective preceding segments due to their great constriction. All seven pairs of legs are strongly prehensile, the first three being directed forward, the last four backward. The second pair are decidedly stronger than any of the others; the seventh pair are uniquely distinctive.

In order to emphasize the validity of the present species it has seemed advisable to present a critical comparative diagnosis of the seventh legs of three adult female specimens, representing, respectively, *I. geei*, *I. japonensis*, and *I. jellinghausii*, which yields the following results:

I. geei: Coxopodite rudimentary; basipodite conspicuously constricted basally, its greatest width occurring midway the distal end, the outer margin distinctly keeled and deflected, only the distal end approaching true convexity, the point of union with the ischium is emphasized by a break in the marginal line, the inner side bears a distinct groove near the basal end on either side of which the margin is accentuated and reflected outwards, the distal end is convexly produced, this sculpturing of the entire inner margin dovetails with the flattened inner margin of the ischium, thus greatly enhancing the strength of the limb. The ischium has the form of an inverted triangulate pyramid, with each side slightly concavely depressed and the inferior margin flattened. The merus is nearly half as long as the ischium, wider than long, the outer margin broadly, roundly produced into a flaring lobe. The inner distal area is only very little produced and extends only a trifle along the inner side of the carpus in striking contrast to that of *I. japonensis* Richardson; the distal margin of the merus is also differently sculptured, the articulation of the carpus with the merus is also different from that of *japonensis* The carpus of the present species is approximately as large as the *merus* of *japonensis*, although the specimen of *geei* is 23.1 mm. long, while *japonensis* is 14.2 mm. long. In shape the carpus of *geei* is

quite similar to its merus; its contour and proportions are quite different from the carpus of *I. japonensis*. The propodus of *I. geei* is relatively stout, evenly curved, not quite as long as the dactyl, which forms a strongly curved hook extending upon and overlapping midway on the inner side of the carpus. It will be noted that this hook is more strongly pronounced and differently bent from that of any of the previously described species of the genus.

I. japonensis: Coxopodite rudimentary; basipodite slightly wider basally than distally, the outer side is relatively convex, not conspicuously keeled; the distal end broadly, roundly shouldered, its point of union with the ischium preserving the unbroken marginal line; the inner side bears a distinct groove, which widens near the basal end; the margins on either side are distinct, slightly produced. The ischium is as long as the basipodite, narrow, subcylindric basally, widening distally, roundly thickened along the inner side and with the outer distal portion reduced, flattened. The merus is slightly wider than long, the outer margin evenly rounded, the inner distal area strongly produced projecting along nearly seven-eighths of the length of the inner side of the carpus; the distal margin of the merus is strongly deeply excavate, encupping the carpus and reenforcing it on the inner side. The carpus is shorter than the merus, subcylindrical, with the inferior margin so little produced that the "rounded expansion" is visible only at the outer basal area tapering to a hair's breadth at the distal end. The propodus is slightly longer than the carpus and only a trifle narrower and is evenly recurved. The dactyl is relatively stout basally, but curves somewhat and tapers to a very fine point, which is directed toward the distal end of the carpus but barely reaches the extreme tip of the margin of the carpus.

I. jellinghausii: Coxopodite rudimentary, basipodite but little constricted basally and upcurved, relatively convex, distal end pronouncedly shouldered, forming a blunt right-angled projection on the outer distal margin; the line of union with the ischium is relatively straight, the side is convex, in marked contrast to that of *geei*. The ischium has the form of an inverted truncated triangulate pyramid, with the sides not concavely depressed and the margins scarcely at all produced. The merus is more than half as long as the ischium, slightly longer than wide; the outer margin roundly produced but with a relatively less flaring lobe than either of its allies. The produced inner distal area extends less along the inner side of the carpus than in *geei*. The articulation of the carpus with the merus is also distinctive; the carpus is compressed, subpyriform; the propodus is a trifle longer than the carpus, is less pronouncedly curved than is *geei* or *japonensis*. The dactyl is differently inserted basally,

moderately curved, tapering to a fine point, which is reflected almost straight back on the carpus, but does not reach the merus.

Male.—The male is similar to the female in general appearance, but is distinctly smaller, the largest full-grown specimen being only 14.2 long and 8 mm. wide; the body outline is more elongate ovate and only slightly convex; the telson is not quite so long and is more rounded posteriorly; the uropoda are relatively larger and are slightly conspicuous dorsally; and the pleopoda cover almost the entire ventral cavity, but not quite extending to its terminal margin.

As is the case with many of the parasitic Cymothoidea, the present species is not pronouncedly different in general appearance from its allies; in fact, a superficial diagnosis would quite probably designate it a form of *Ichthyoxenus japonensis* Richardson, but a critical comparison of the entire series of specimens of the present species with the entire series of *I. japonensis* Richardson, including the type material, and likewise with the series of *I. jellinghausii* Herklots in the United States National Museum, augmented by careful study of all the literature on the group *Ichthyoxenus*, especially that of *I. montanus* Schioedte and Meinert, of which no specimens were available, consideration of this species being necessarily based on the text and Schiodte's and Meinert's excellent figures of the various phases of the species, establish beyond question the fact that *I. geei* is as distinct specifically as the three previously described members of the genus.

The adult females of *I. geei* are uniformly less asymmetrical in contour than those of *I. japonensis;* the insertion of the head of *geei* is distinctive; the number of ocelli and the shape of the eye of *geei* differs from that of *japonensis;* the posterior margin of the first thoracic segment of *geei* is relatively a straight line, while in *japonensis* this is uniformly recurvate. The proportionately larger and broader telson and the relatively smaller pleopoda and uropoda of the female is distinctive of *geei*, as are the uniquely different seventh pair of legs. Finally, the differently shaped and proportionately much smaller maxillipeds of *geei* preclude its confusion with the other members of the genus.

It is interesting to note that all the so far recorded hosts of the members of the genus *Ichthyoxenus* are confined to the fresh-water fishes of the closely related families Cobitidae and Cyprinidae.

Type.—An adult female, Cat. No. 53304, U. S. N. M., and an adult male paratype, were found parasitic in "Tsi-fish," or carp, probably *Cyprinus carpio* Linnaeus, taken from lakes and canals around Soochow, China. The following additional paratypes—two males, one female—and about 40 very young specimens, Cat. No. 53305, U. S. N. M., were likewise collected by Prof. N. Gist Gee, of Soochow University, for whom I take great pleasure in naming the species.

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EXPLANATION OF PLATES.

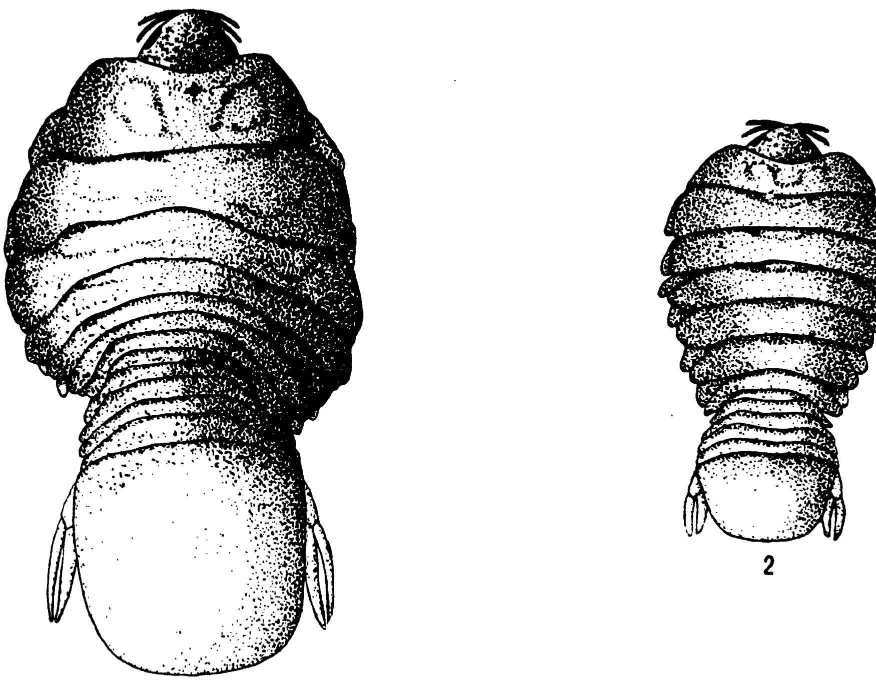
PLATE 40.

FIG. 1. *Ichthyoxenus geei*, new species, female, type.
2. *Ichthyoxenus geei*, new species, male, paratype.

PLATE 41.

FIG. 1. *Ichthyoxenus geei*, seventh leg of female.
2. *Ichthyoxenus jäponensis* Richardson, seventh leg of female.
3. *Ichthyoecxnus jellinghausii* Herklots, seventh leg of female.
4. *Ichthyoxenus geei*, new species, maxilliped.
5. *Ichthyoxenus japonensis* Richardson, maxilliped.

[1] I have not been able to obtain this paper.



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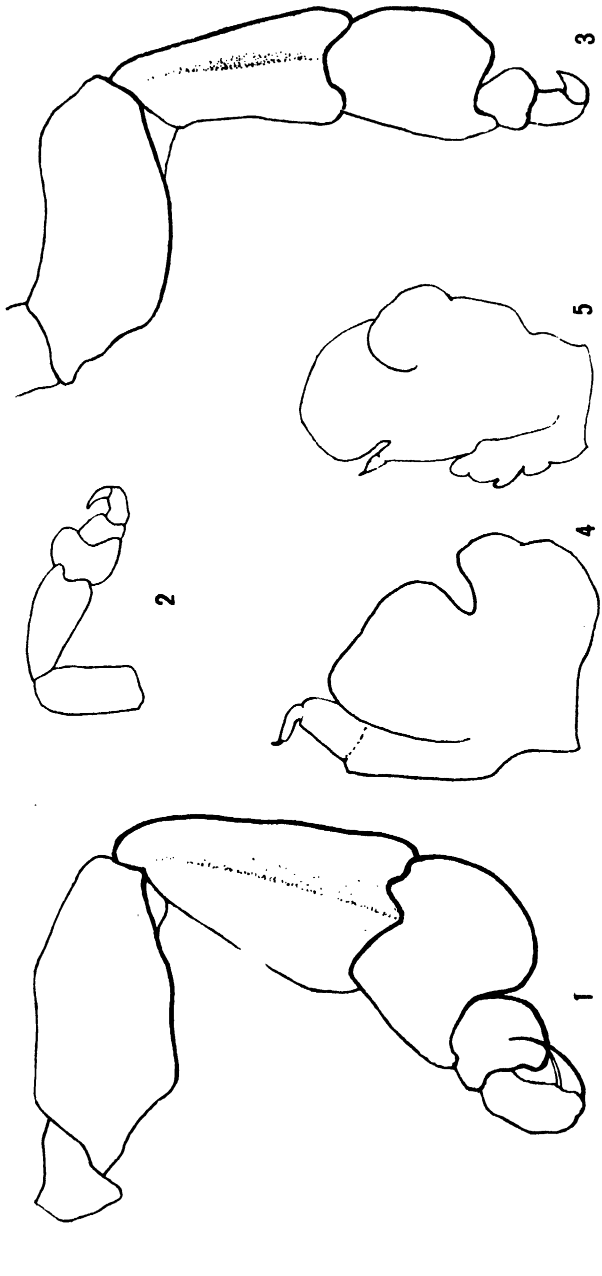
ICHTHYOXENUS GEEI. (1) FEMALE, (2) MALE.

FOR EXPLANATION OF PLATE SEE PAGE 502.



PARTS OF DIFFERENT SPECIES OF ICHTHYOXENUS CONTRASTED.

FOR EXPLANATION OF PLATE SEE PAGE 502.

THE NORTH AMERICAN ICHNEUMON-FLIES OF THE TRIBE ACOENITINI.

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INTRODUCTION.

This paper is a revision of the tribe Acoenitini as defined by Cushman and Rohwer[1] and as represented in the North American fauna. Of the five genera included only two, *Coleocentrus* Gravenhorst and *Arotes* Gravenhorst, are known to occur in our region and only these two are treated at length, though all five are tabulated in the key to genera. *Coleocentrus* has been revised by the senior author and *Arotes* by the junior author, and new species should be ascribed to the individual responsible for the descriptions.

The present study is based on examination of all the available types of described North American species of *Coleocentrus* and *Arotes* and the rather extensive representation of these two genera in the collection of the United States National Museum, together with specimens of the genotypes of all three of the extralimital genera.

The illustrations used in this paper were made from drawings prepared under the writers' supervision by Miss Mary Carmody, formerly of the branch of Forest Insects, Bureau of Entomology.

Tribe ACOENITINI Cushman and Rohwer.

The members of this tribe are medium-sized to large insects chiefly remarkable for the extreme vomeriform hypopygidium in the female. In this respect they are distinct from all other Ichneumonidae. Aside from this the tribe is rather closely allied to the more typical ichneumonine tribes Rhyssini, Xoridini, etc.

The members of this tribe, so far as their host-relations are known, are parasitic on wood-boring coleopterous, hymenopterous, and lepidopterous larvae.

Tribal characters.—Head transverse, broad behind eyes; eyes not emarginate within, parallel or nearly; malar space distinct; mandibles bidentate apically, teeth subequal; occipital carina complete; scutum longer than the propodeum, but not especially lengthened, never

[1] Proc. U. S. Nat. Mus., vol. 57, 1920, p. 395.

transversly rugose; scutellum convex, not margined laterally; mesepisternum not especially lengthened; legs rather long, none of the parts especially robust, posterior femora not dentate; abdomen polished, without elevations or furrows, petiolate to subsessile, compressed apically; hypopygidium in female large, vomeriform; ovipositor long, compressed or subcompressed, acute at apex with a more or less distinct dorsal angulation some distance back from apex, lancets enclosing lance laterally at extreme apex.

KEY TO THE HOLARCTIC GENERA.

1. Propodeal spiracle round or long oval and placed near base of segment; last joint of hind tarsus distinctly shorter than second; apical tergite elongate, prominent, and more or less trowel-shaped; clypeus distinctly separated from face medially; malar furrow obsolete; front and middle claws simple; nervellus strongly reclivous, broken far above middle .... *Coleocentrus* Gravenhorst.

   Propodeal spiracle long oval or slit-like and placed at about the middle; last joint of hind tarsus distinctly longer than second; apical tergite not elongate; clypeus usually not distinctly separated from face medially; malar furrow distinct; front and middle claws usually finely bidentate at apex; nervellus perpendicular or slightly reclivous, broken at or not far above middle .... 2.
2. Abdomen very narrowly petiolate, first tergite much more than twice as long as wide at apex, the spiracles at about the middle; second recurrent vein antefurcal or interstitial; front wings usually more or less infumate at apex; entire body pale or contrastingly colored in black and yellow or whitish; antennae long and slender, usually annulated .... *Arotes* Gravenhorst.

   Abdomen rarely petiolate, and if so the spiracles of 1st tergite are far before middle; if spiricles are in the middle the tergite is much broader; second recurrent postfurcal; front wings immaculate; head and thorax immaculate black, abdomen unicolored or bicolored black and rufous; antennae short and stout, not annulated..3.
3. Wings with an areolet; front and middle claw simple; clypeus broadly subtruncate and reflexed at apex, without a median tooth or angle; malar space little more than half as long as basal width of mandible; sternauli practically absent; notauli deep and meeting before the scutellum; propodeal carinae weak.
   Mesoclistus Foerster.

   Wings without areolet; front and middle claws bidentate at apex; clypeus truncate and at least angulate medially; malar space nearly or quite as long as basal width of mandible; sternauli well defined .... 4.
4. Notauli very weak, scarcely at all impressed; propodeal carinae weak; prepectal carina weak and terminating low down on pleura; first tergite nearly or quite as wide at apex as long, the spiracles nearly in the middle..*Acoenites* Latreille.

   Notauli strong and complete, meeting some distance before scutellum; propodeal carinae strong; prepectal carina very strong and reaching nearly to dorsal margin of pleura; first tergite nearly or twice quite as long as wide at apex, the spiracles distinctly before the middle....*Phaenolobus* Foerster (=*Chorischizus* Foerster).

Genus COLEOCENTRUS Gravenhorst.

Coleocentrus Gravenhorst, Ichn. Eur., vol. 3, 1829, p. 437. *Genotype.—Ichneumon excitator* Poda.

From all the other genera of the tribe this genus differs in the basal position of the propodeal spiracle, the short apical joint of the hind tarsus, the long terminal tergite, and the obsolete malar furrow.

Biological habits.—The members of this genus are parasitic on wood-borers, both hymenopterous and coleopterous.

Generic characters.—Head transverse, not especially widened behind the eyes; clypeus distinctly separated, inflexed at apex, with a median tooth; malar space rather long; face flat; eyes and ocelli moderate; antennae about two-thirds as long as body, filiform, attenuate apically. Thorax stout, oblong, weakly arched above; notauli deep, complete, meeting on disk of mesoscutum, prescutum prominent; prepectal carina nearly obsolete except briefly below; propodeum with more or less distinct apical, median, and lateral carinae, spiracle placed much before middle, long oval to nearly round; areolet, when present, oblique trapezoidal and petiolate, frequently absent; legs, especially posterior, long and rather slender, with hind basitarsus fully as long as remaining joints combined, apical joint much shorter than second, claws simple. Abdomen clavate;

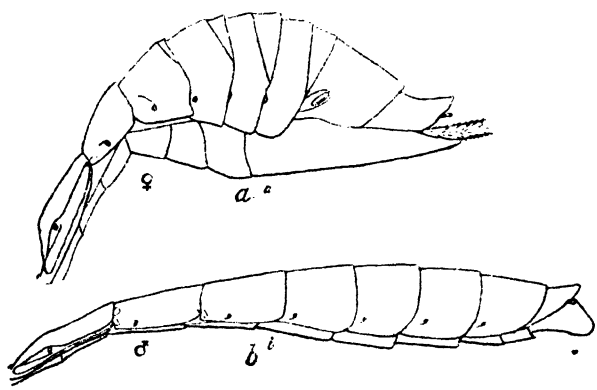


FIG. 1.—COLEOCENTRUS OCCIDENTALIS. SIDE VIEW OF ABDOMEN; *a*, FEMALE; *b*, MALE.

first tergite with spiracle much before middle; dorsal carinae developed only at base; last tergite long and scoop-like or trowel-shaped; last abdominal spiracle in female very large oval; ovipositor usually slightly shorter than body, occasionally as long, and strongly compressed.

The male is much less robust than the female, especially in the abdomen, which is slender throughout; the face, scape, and front and middle legs are paler than in the female; the sheaths of the genitalia are very large and obliquely truncate at apex; the last abdominal spiracle is normal.

Specific characters.—The most conspicuous specific characters are found in the color and color pattern of the body, the presence or absence of the areolet in the front wing; the form of the clypeus; the color of the wings and legs, especially the coxae and hind tarsi; the form of the propodeal spiracle; the comparative proportions of the first tergite; and the size of the ocelli. This set of characters serves to

separate the twelve known North American species, and are the characters used in the following key:

KEY TO SPECIES.

1. Antennae banded with white; head entirely black (male) *mellipes* Provancher.
   Antennae unicolorous; face, at least in male, with yellow markings............2.
2. Areolet wanting..3.
   Areolet present..5.
3. Face rugose; palpi and tegulae yellow; ovipositor longer than body. *flavipes* (Provancher).
   Face smooth; palpi and tegulae, the latter at least apically, piceous; ovipositor shorter than body..4.
4. Wings hyaline; clypeus so sharply inflexed as to appear truncate, with the median tooth very small.................................*minor* Cushman.
   Wings yellowish; clypeus less sharply inflexed, with the median tooth broad and obtuse..*niger* Cushman.
5. Thorax black...6.
   Thorax reddish brown...10.
6. Coxae in female entirely red; abdomen black with tergites whitish at apices; male unknown..*harringtoni* Cushman.
   Coxae black or piceous at least basally within (in male front and middle coxae pale at apex, occasionally entirely pale and rarely the hind coxae are entirely red)...7.
7. Abdomen more or less red; all coxae in female dark piceous red, blackish at base (in male the red is paler and the piceous more nearly black and the hind coxae sometimes uniformly piceous); face in female usually maculate with yellowish, in male yellow but with clypeus black; tegulae reddish....*occidentalis* Cresson.
   Abdomen usually entirely black (in known male, more or less piceous red in middle) or with apical tergites white margined; all coxae in female and in known male black; both face and clypeus in known male yellow...........8.
8. Inner orbits, tegulae and a spot in front, and stigma reddish; apical tergites margined with whitish; ovipositor longer than body. (Male not known.) *quebecensis* Provancher.
   Head in female entirely black; stigma except at base blackish; abdomen black, occasionally piceous red in middle, tergites not margined with whitish; ovipositor shorter than body..9.
9. Malar space in female barely two-thirds, in male less than half as long, as basal width of mandible; wings distinctly suffused with yellowish, especially basally; areolet with petiole barely half as long as free portion of first intercubitus; legs pale stramineo-testaceous, hind tibiae nearly black......*pettitii* Cresson.
   Malar space in female nearly, in male fully, half as long as basal width of mandible; wings infumate, not yellowish basally; areolet with petiole nearly as long as free portion of first intercubitus; legs dark rufo-testaceous, hind tibiae but little darker than femora......................................*manni* Cushman.
10. Wings very dark brownish with purplish reflections; hind tarsus not much paler than tibia, latter not black apically; malar space much shorter than basal width of mandibles; membraneous apical portion of tergites darker than chitinized portion. (Female only).............................*pulchripennis* Cushman.
    Wings subhyaline; hind tarsus yellow, tibia infuscated at apex; malar space but little shorter than basal width of mandible; membraneous portion of tergites paler than chitinized portion..11.

11. Propodeal spiracle nearly circular; first tergite much more than half as wide at apex as long, and not deeply impressed on each side near apex; diameter of lateral ocellus fully two-thirds as long as ocellocular line; vertex and frons black. (Female only)....................................*rufus* Provancher.
Propodeal spiracle elongate oval; first tergite barely half as wide at apex as long and deeply impressed on each side near apex; diameter of lateral ocellus little more than half as long as ocellocular line; vertex and frons not black...*similis* Cushman.

COLEOCENTRUS MELLIPES Provancher.

Coleocentrus mellipes PROVANCHER, Addit. Faun. Ent. Can., Hym., 1889, p. 113, male.

Discussion based on original descriptions.

During his visit to Quebec for the examination of the Provancher types, Mr. Rohwer was unable to find the type of this species, nor is it listed in Provancher's manuscript catalogue. I am of the opinion that it is not a *Coleocentrus*, the banded antennae, immaculate head, and almost entire lack of propodeal carinae distinguishing it from any other species of the genus. I can not, however, definitely place it from the description and retain it in the present genus provisionally. The banded antennae suggest such genera as *Echthrus*, *Exetastes*, *Arotes*, and *Xorides*, but other characters mentioned in the description exclude it from any of those genera.

COLEOCENTRUS FLAVIPES (Provancher).

Acoenites flavipes PROVANCHER, Nat. Can., vol. 6, 1874, p. 80, female. *Type.*—Dernière Prov. Coll., Public Mus., Quebec. Yellow label 1249.
Acoenites canadensis PROVANCHER, Nat. Can., vol. 12, 1880, p. 10, male. *Type.*—Dernière Prov. Coll., Public Mus., Quebec. Yellow label 375.

Discussion based on original description and notes by Mr. Rohwer on types.

The lack of the areolet led to the description of this species in *Acoenites* and the failure to understand the sexual antigeny to the redescription in the male. Mr. Rohwer, who examined the types, considers *canadensis* as most certainly the male of *flavipes*.

Mr. Rohwer's notes contain the following:

Runs to *Coleocentrus* and agrees in all characters except the absence of the areolet; also agrees in habitus. It will not fit any other genus in the table. Clypeus truncate with a very small median tooth. In size it is very like *C. similis* Cushman (Type). Other than the color and absence of areolet only the following differences are noted; clypeus more truncate; longitudinal carinae on propodeum more widely separated; first tergite with the longitudinal depression a trifle deeper, and the ovipositor a trifle longer.

The rugosity of the face, credited to this species by Provancher, is, if present, certainly very curious for this genus. Mr. Rohwer made no note on this point.

COLEOCENTRUS MINOR Cushman, new species.

Evidently closely allied to *flavipes* (Provancher) from which the smooth face, piceous palpi and tegulae, and shorter ovipositor readily distinguish it.

Female.—Length, 15 mm.; antennae (entire flagellum of both missing); ovipositor, 11 mm.

Head polished, impunctate, temples weakly convex, strongly sloping; face three-fourths as long as wide; clypeus so sharply inflexed that it appears truncate, the median tooth very small; malar space slightly shorter than basal width of mandible; diameter of lateral ocellus less than postocellar line, which is about three-fourths as long as ocell-ocular line. Thorax polished, more or less obscurely sculptured laterally and ventrally, especially on pronotum; propodeum nearly as long as depth of propodeum and metapleura, coriaceously roughened, with the petiolar area sharply separated and highly polished, longitudinal carinae weak, spiracles broad oval; areolet lacking. Abdomen a half longer than head and thorax, sculpture granular, more or less striate basally and subpolished apically; first tergite three-fifths as wide at apex as long and about a third longer than second; hypopygidium fully half as long as abdomen.

Piceous black; head immaculate, but with faint paler piceous reflections above clypeus; palpi and underside of scape and pedicel fusco-piceous; legs pale testaceous, hind femur at apex, tibia, tarsus, and apical joints of middle tarsus fuscous; tegulae white, piceous at apex; wings hyaline, veins and stigma fuscous, latter white at base; abdomen somewhat paler than thorax except at tip.

Type locality.—Pisgah Ridge, North Carolina.

Type.—Cat. No. 20773, U.S.N.M.

One female under Hopkins U. S. No. 3558, which number refers to a note by W. F. Fiske recording it as having been reared, May 26, 1905, as a parasite of a cerambycid (*Leptura* ?) in a dead branch of *Viburnum.*

COLEOCENTRUS NIGER Cushman, new species.

Allied in its lack of an areolet to *minor* Cushman, but in general habitus, length of propodeum, and clypeus more closely allied to *harringtoni* Cushman.

Female.—Length, 18 mm.; antennae (flagella missing); ovipositor, 13 mm.

Head very delicately shagreened, subpolished; face two-thirds as long as wide, shallowly impressed each side of middle; clypeus moderately inflexed, tooth broad and obtuse; malar space slightly shorter than basal width of mandible; frons arcuately striate; temples flat, sharply sloping; diameter of lateral ocellus nearly as long as postocellar line, which is about two-thirds as long as ocellocular line. Thorax coriaceous, subpolished, mesoscutum nearly smooth; propodeum much shorter than depth of combined propodeum and metapleura, petiolar area very short, more or less longitudinally rugose, sharply separated, longitudinal carinae subobsolete, spiral broadly oval. Abdomen two-thirds longer than head and thorax,

finely granular, coriaceous basally, subpolished apically; first tergite fully two-thirds as wide as long and barely a half longer than second; hypopygidium slightly less than half as long as abdomen.

Black with piceous reflections on head and abdomen; clypeus at apex, supraclypeal spot on each side of face, scape and pedicel below piceous; palpi fuscous; tegulae pale piceous; wing yellowish, veins and stigma dark, latter whitish at base; legs testaceous, hind tibiae and all tarsi more or less infuscate; tergites beyond third with membraneous apical portion whitish.

Type locality.—Whitefish Point, Michigan.

Type.—Cat. No. 21193, U.S.N.M.

One female collected by A. W. Andrews, July 26, 1914.

COLEOCENTRUS HARRINGTONI Cushman, new name.

Coleocentrus canadensis HARRINGTON, Can. Ent., vol. 25, 1892, p. 29, female. [Not (*Acoenites*) *Coleocentrus canadensis* (Provancher) 1880]. *Type.*—Coll. Harrington, Ottawa, Canada. Good condition.

Discussion based on notes from type by Mr. Rohwer and two other females.

The specific name *canadensis* is preoccupied in *Coleocentrus* by *canadensis* Provancher, described in *Acoenites* and here synonymized with *flavipes* Provancher. Two females in the United States National Museum agree with Harrington's description and, according to Mr. Rohwer, who has seen the type, are Harrington's species.

Very similar in general form and color to *niger* Cushman, but larger and with an areolet; face punctured, barely half as long as wide; temples broad, scarcely sloping; lateral ocelli scarcely more than half as wide as ocellocular line; thorax more strongly sculptured; propodeum relatively longer, all carinae prominent, spiracle long oval; first tergite nearly twice as long as wide; ovipositor nearly as long as body.

The two specimens are 25 and 22 mm. long, with the ovipositor about 4 mm. shorter.

This species is closely allied to the genotype, *Coleocentrus excitator* Gravenhorst, which, however, has the apical carina of the propodeum incomplete medially and the coxae black.

Neither of the United States National Museum specimens is labeled.

COLEOCENTRUS OCCIDENTALIS Cresson.

Coleocentrus occidentalis CRESSON, Proc. Acad. Nat. Sci. Phila., 1878, p. 376, female. *Type.*—Acad. Nat. Sci. Phila., No. 1431.

Discussion based on type, homotype, four other females, and eight males.

In general form and structure much like *harringtoni* Cushman and differing principally in color. Compared with *harringtoni* differs as follows: Face two-thirds as long as wide; ocelli larger, diameter of lateral ocellus two-thirds as long as ocellocular line; black with the

abdomen in the female largely red in the middle, in the male more or less so; coxae more or less black or piceous at least at base; palpi, clypeus, face at sides and below antennae, scape and pedicel beneath, tegulae, and legs reddish, hind tibiae fuscous at apex, tarsi yellowish.

The male differs from the female principally in color, the red of the abdomen being confined largely to the sutures and the sides of

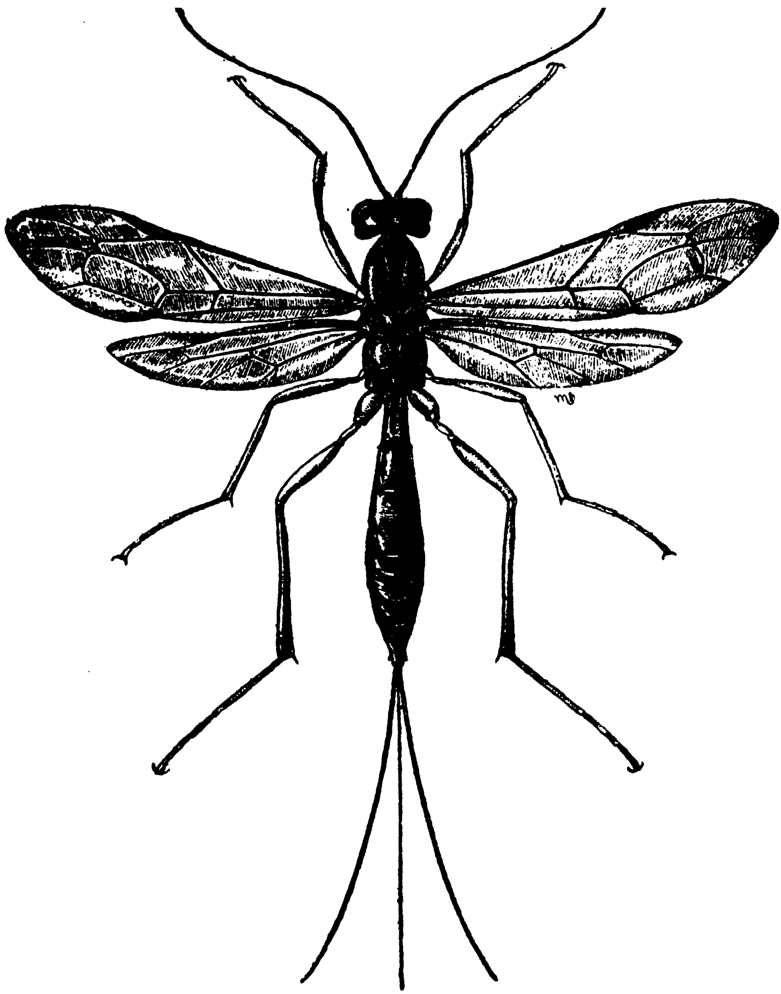


FIG. 2.—COLEOCENTRUS OCCIDENTALIS CRESSON. ADULT FEMALE ENLARGED ABOUT 3 DIAMETERS.

tergites 2 and 3, the entire yellow face and the paler appendages, the hind coxae, however, being frequently entirely black or piceous, though occasionally largely testaceous.

The normal size of this species is in the neighborhood of 25 mm., but one of the females, taken by W. M. Mann on San Juan Island, Washington, is only 17 mm. long.

Represented in the United States National Museum by five females (one a homotype by Mr. Rohwer) and eight males, all from the Northwest, ranging through Vancouver, Washington, Oregon, and Idaho.

The only biological data consists in a note on one of the females labeled "Hopkins U.S.No. 1061," which was taken on a dead hemlock log, August 26, 1902, at Junction, Washington, by A. D. Hopkins.

COLEOCENTRUS QUEBECENSIS Provancher.

Coleocentrus quebecensis PROVANCHER, Nat. Can., vol. 6, 1874, p. 79, female.

Discussion based on original description.

Provancher himself reduced this species to synonymy with *pettitii* Cresson. But his description differs from that species by the characters used in the above table to species. In his examination of Provancher's types, Mr. Rohwer was unable to find a specimen labeled *quebecensis*, but did find one labeled *pettitii*. Concerning his findings he wrote the following note:

> Type not in Public Museum, Quebec, unless it is a specimen labeled as *pettitii* Cresson. *C. pettitii* of Provancher is *pettitii* of Cushman's manuscript table.

The humeral red spot, unless merely a not fully colored area, is very unusual for the genus.

COLEOCENTRUS PETTITII Cresson.

Coleocentrus pettitii CRESSON, Can. Ent., vol. 1, 1868, p. 35, female. *Type.*—Acad. Nat. Sci. Phila., No. 1430.

Discussion based on type, homotype, and one other female.

The strongly contrasting black body and coxae and pale red legs makes this species very readily recognizable.

Compared with *niger* Cushman, the homotype differs, in addition to the characters used in the key, as follows: Head polished; face finely punctured; temples convex, rather broad; diameter of lateral ocellus little more than half as long as ocellocular line; petiolar area of propodeum not especially short, longitudinal carinae strong, spiracle long oval; abdomen more polished; first tergite barely half as wide as long, and less than a half longer than second; hypopygidium much less than half as long as abdomen; ovipositor three-fourths as long as body.

Head, thorax, abdomen, and all coxae black; clypeus, tegulae, venter, and narrow apical margins of tergites piceous; legs pale red, hind tibiae fuscous, especially above and at apex, their tarsi yellow.

In size very similar to *niger*. Labeled: "North Mt., Pa., 6. 9."

The other specimen is somewhat smaller, but otherwise very similar. It was taken at Kentville, Nova Scotia, June 29, 1916.

There is a male in the collection of the Academy of Natural Sciences of Philadelphia. It is labeled by Davis with a manuscript

name and referred to the genus *Xenoschesis* Foerster. It has the second and third tergites piceous laterally, the face and clypeus yellow, and front and middle coxae piceous in front, but is otherwise very similar to the female.

In the United States National Museum collection is a male from the same locality and captured on the same date as the homotype, which I believe to be an abnormally colored specimen of this species. It has the front and middle legs, except posterior side of femora, the hind coxae in front and their trochanters, the tegulae, face, clypeus, and scape below yellow; the hind coxae, and front and middle femora, except as noted, and the hind femora are testaceous. In structure it is exactly what the male of *pettitii* should be.

COLEOCENTRUS MANNI Cushman, new species.

Related to *pettitii* Cresson, from which, in addition to the key characters, it differs principally as follows:

Female.—Length, 15 mm.; antennae, 10 mm.; ovipositor, 10 mm Face practically impunctate, polished; propodeum barely three-fourths as long as combined height of propodeum and metapleurum, spiracle distant by its length from pleural carina (in *pettitii* it is distinctly closer to the carina); first tergite fully half as wide at apex as long; nervulus nearly perpendicular and nearly interstitial (in *pettitii* it is strongly oblique and distinctly postfurcal); subdiscoideus but little below middle of apex of second discoidal cell.

Male.—Length, 13 mm.; antennae, 12 mm. Differs from female in having face, clypeus, scape below, palpi, tegulae (at least basally) yellow; legs generally paler, with front and middle coxae in front at apex, all trochanters in front, front and middle femora at apex and their tibiae in front yellow, hind tibiae and femora more contracting in color; second to fourth tergites laterally and their sternites more or less reddish. In the venational characters, except that of the areolet, the male shows gradation toward *pettitii*.

Type locality.—Orens Island, Washington.

Other locality.—Blue Mountains, Washington.

Type.—Cat. No. 22102, U.S.N.M.

Described from one female and two males, the female captured July 14–30, 1909, by W. M. Mann, and the males July 15, 1896, by C. V. Piper.

COLEOCENTRUS PULCHRIPENNIS Cushman, new species.

Female.—Length, 22 mm.; antennae, 15 mm.; ovipositor, 17 mm. Differs from all the other North American species in its very dark wings.

Head subpolished, sparsely punctate, except on face where punctation is rather dense, and lower posterior orbits where it is impunc-

tate; clypeus rather sharply inflexed, the median tooth broad and obtuse; malar space three-fourths as long as basal width of mandible; face two-thirds as long as wide; frons deeply concave, arcuately rugose; temples convex, rather sharply sloping; diameter of lateral ocellus slightly shorter than postocellar line and two-thirds as long as ocell-ocular line. Thorax coriaceous, the sculpture a mixture of irregular rugosity and punctuation; propodeum much shorter than height of combined propodeum and metapleura, carinae rather strong, petiolar area rather long, spiracle long oval. Abdomen three-fourths longer than head and thorax combined; first tergite hardly half as wide as long, about a third longer than second; hypopygidium about half as long as abdomen.

Rufous; face uniformly slightly paler; mandibles and clypeal tooth piceous; occiput, frons, vortex, and superior orbits black; antennae blackish, scape, pedicel, and first flagellar joint red beneath; scutellum and tegulae slightly more yellowish; legs testaceous, tarsi and front and middle tibiae yellowish; wings dark brownish with purple reflections; membraneous portion of tergites dark brown; ovipositor sheaths black.

Type locality.—Tuolumne County, California.

Type.—Cat. No. 21194, U.S.N.M.

One female collected by D. W. Coquillet.

COLEOCENTRUS RUFUS Provancher.

Coleocentrus rufus PROVANCHER, Nat. Can., vol. 8, 1876, p. 316, female. *Type*—Prov. 1877 coll., Public Museum, Quebec; yellow label 456.

One female in the United States National Museum agrees perfectly with Provancher's description, and Mr. Rohwer, who has seen the type, is of the opinion that the determination is correct.

Related to *pulchripennis* Cushman, differing principally as follows: Head polished, impunctate; frons very shallowly concave, rugosity weak; temples strongly convex, broad, and weakly sloping; diameter of lateral ocellus equal to postocellar line and fully three-fourths as long as ocellocular line; propodeal carinae sharp; spiracle nearly round; first tergite much more than half as wide as long, nearly a half longer than second; ovipositor much shorter, the measurements being—body, 20 mm.; ovipositor, 12 mm.

Colored like *pulchripennis* except as follows: Face yellow with a median oval red spot; clypeus reddish at base, yellowish at apex, the tooth red; mandibles piceous only at apex; cheeks piceous; black of top of head confined to frontal spot from ocelli to antennae, occiput and posterior portion of vertex and upper orbits, space between ocelli red; thoracic sutures and extreme base of first tergite black; tegulae distinctly yellow; front and middle knees pale; hind tibiae

infuscate especially apically, their tarsi lemon yellow; wings subhyaline; membraneous portion of tergites yellowish.

Taken at Whitefish Point, Michigan, July 4, 1913, by A. W. Andrew.

COLEOCENTRUS SIMILIS Cushman, new species.

Female.—Length, 15 mm.; antennae, 10 mm.; ovipositor, 9 mm.

Related to *rufus* Provancher, but easily distinguished from that species by the characters used in the table. It differs further in the yellow clypeus; red temples; paler front and middle tibiae and tarsi, these being yellow; more or less black or piceous inner surfaces of hind coxae; narrower temples; weaker propodeal carinae; and longer propodeum, this being fully three-fourths as long as combined height of propodeum and metapleura; otherwise much like *rufus.*

Male.—Length, 15 mm.; antennae (broken). Head and thoracic structure much as in female, the latter more slender; malar space barely half as long as basal width of mandible, temples broader, nearly straight; ocelli slightly larger; propodeum nearly as long as combined height of propodeum and metapleura; first tergite less than a third as wide as long, its spiracles prominent, others parallel sided; face, clypeus, scape, and pedicel below, and a narrow orbital line opposite antennae pale lemon yellow, as are also entire front and middle legs except posterior side of femora and coxae.

Type locality.—Montgomery County, Pennsylvania.

Other localities.—Dead Run, Fairfax County, Virginia; Glencarlyn, Virginia; Inglenook, Pennsylvania; Forest Glen, Maryland.

Type.—Cat. No. 21195, U.S.N.M.

Described from five females and one male, the type and allotype from the type locality, paratype *a* from Dead Run, Virginia. (R. C. Shannon); paratype *b* from Glencarlyn, Virginia. (N. Banks) paratype *c* from Inglenook, Pennsylvania. (W. S. Fisher); and paratype *d* from Forest Glen, Maryland. (F. Knab).

Except for their generally darker color paratypes *a, b,* and *d* are practically typical. Paratype *c* is considerably larger, generally darker, and has the first tergite relatively wider than in the type.

SPECIES ERRONEOUSLY REFERRED TO COLEOCENTRUS.

Lampronota edwardsii CRESSON, Proc. Acad. Nat. Sci. Phila., 1878, p. 379, female.

Synonymized by Dalla Torre with *Coleocentrus rufus* Provancher. Synonymy wrong. It is a Lissonotine.

Coleocentrus texanus ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1889, p. 144.

Later referred by Ashmead to the Cryptine genus *Nematopodius* Foerster, but is the genotype of the Cryptine genus *Derocentrus* Cushman.[1]

[1] Proc. Ent. Soc. Wash., vol. 21, 1919, p. 113.

Genus AROTES Gravenhorst.

Arotes GRAVENHORST, Ich. Eur., vol. 3, 1829, p. 446. *Genotype.—Arotes albicinctus* Gravenhorst (Monobasic).

Sphalerus KRIECHBAUMER, Ent. Nachr., vol. 4, 1878, p. 41. *Genotype.*—(*Sphalerus bifasciatus* Kreichbaumer)=*Arotes albicinctus* Gravenhorst (Monobasic).

Although the genus *Arotes* is very easily distinguished from the allied genera it has not been entirely understood by American authors as is evidenced by the fact that although Cresson[1] tabulated the species in 1869 he described a new species in 1870, referring it to *Aconeites*. By the distinctly petiolate abdomen with spiracle of the first tergite placed at about the middle the species of *Arotes* are easily distinguished from those of the other genera of this tribe.

Generic characters.—Clypeus flat or somewhat depressed basally, the apical margin truncate or slightly, shallowly emarginate; antennae long, slender; notauli complete, meeting before the anterior margin of scutellum; prepectal carina strong extending to or nearly to the top of the mesepisterum; sternauli wanting; propodeum short with nearly complete areolation, the spiracle elongate and placed at about the middle; legs long, slender or the hind femora somewhat more robust; claws long, curved and toothed within; abdomen petiolate, the first tergite fully three times as long as apical width, the spiracles placed at about the middle; ovipositor longer than abdomen; areolet wanting; recurrent antefurcal or interstitial; nervellus slightly reclivous or perpendicular, broken at about the middle. Species either uniformly pale or black with yellowish marks.

In the key to the American species published by Cresson the position of the recurrent vein in relation to the intercubitus was considered of specific value, but the additional material has proven that this character is subject to individual variation. The areolation of the propodeum is also variable and not of specific value. Color is fairly constant and when used with care offers the best means of distinguishing the species.

KEY TO THE SPECIES.

1. Body largely ferrugineous, first tergite and mesepisternum entirely so; small species .... 2.
   Body black or black and yellow; first tergite and the mesoscutum always with black; larger species .... 3.
2. Stigma black; apical margins of the wings dusky antennae with a yellow band .... *melleus* (Say).
   Stigma ferruginous; wings unicolorous, hyaline; antennae uniformly rufous .... *rupinsulensis* (Cresson).
3. Posterior orbits, most of the thorax and propodeum black .... *maurus* Rohwer.
   Posterior orbits, many marks on thorax and propodeum yellowish .... 4.

[1] Trans. Amer. Ent. Soc., vol. 2, p. 200.

4. Hind femora rufous tipped with black; hind coxae black with a white spot above and below .... *decorus* (Say).
   Hind femora mostly black .... 5.
   Hind femora entirely ferrugineous .... 6.
5. Dusky spot surrounding base of radius; cheeks seen from in front full and rounded; mesepisternum of female black .... *formosus* Cresson.
   No dusky spot below stigma; cheeks seen from in front straight, sloping; mesepisternum marked with yellow in both sexes .... *amoenus* Cresson.
6. Females .... 7.
   Males .... 8.
7. Stigma largely yellowish; vertex, and mesoscutum black; apical tergites largely black and contrasting sharply with the yellow hypopygidium. *occiputalis* Cresson.
   Stigma black; vertex and mesoscutum largely rufous; apical tergites largely yellowish ferruginous, the hypopygidium the same color .... *vicinus* Cresson.
8 Stigma largely yellowish; base and apex of first tergite yellow; mesepisternum entirely or almost entirely yellow .... *occiputalis* Cresson.
   Stigma black; first tergite yellow apically the base black; mesepisternum black. *vicinus* Cresson.

AROTES MELLEUS (Say).

Acoenites mellus SAY, Boston Journ. Nat. Hist., vol. 1, 1835, p. 249.—LECONTE, Edition of Say, vol. 2, 1859, p. 703

Type lost, discussion based on a single neotype.

Female.—Length, 9 mm.; length of ovipositor, 8 mm. Face with a few dorsad-ventrad striae centrally, laterally transversely striato-punctate; frons, vertex, and temples without punctures; scutum without punctures; notouli not foveolate; suture in front of scutellum with a few rugae; areola and basal area confluent, the former poorly defined the latter parallel-sided; propodeum almost without sculpture; mesepisternum shining with widely separated, distinct punctures; nervulus antefurcal by about half its length; recurrent distinctly antefurcal. Ferruginous; face, scape beneath and scutellum and metascutellum yellow; a large frontal spot and some sutures of thorax blackish; legs ferruginous, tibiae and tarsi rather paler; antennae brownish with a broad yellow annulus; wings hyaline with the apical margin dusky; venation including stigma dark brown.

Say's specimen came from Indiana; the specimen described above was collected at Delaware Water Gap, New Jersey, July 8.

The neotype differs from Say's description only in the color of the antennae. The original description says: "Antennae white; basal two-thirds above black." It may be that the apical joints of the antennae were wanting in the specimen examined by Say or it is possible that the color of the antennae may vary.

AROTES RUPINSULENSIS (Cresson).

Acoenites rupinsulensis CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 143.—WALSH, Trans. Acad. Sci. St. Louis, vol. 3, 1873, p. 152.

Type, a single female, Cat. No. 2049, Acad. Nat. Sci., Philadelphia.

Besides the characters given in the above key this species may be distinguished from *melleus* by having the scutellum concolorus with

the rest of the thorax; nervulus antefurcal by only twice its width; areola defined laterally; face with distinct punctures which dorsally have a tendency to transverse striato-punctation.

Walsh lists three females and one male, and says the terminal edge of the wings is clouded with dusky. His specimens are lost, so it is impossible to say that they are the same as the Cresson type.

Both the type and the specimens listed by Walsh were collected in Illinois.

AROTES MAURUS Rohwer, new species.

This new species is probably more closely allied to *formosus* Cresson than to any other described form, but the much darker head and thorax readily distinguishes it from that.

Female.—Length, 18 mm.; length of ovipositor, 18 mm. Clypeus depressed basally; face with a median dorsad-ventrad raised line, irregularly wrinkled on each side of this line, shining and with well separated distinct punctures laterally; frons, vertex, and temples smooth, without sculpture; ocelli in a low triangle; the postocellar line one-third shorter than the ocellocular line; scutum polished; notauli feebly foveolate; suture in front of the scutellum with many rugae; ridges on propodeum strong; basal area wider than long; parallel-sided, separated from the areola; areola and petiolar areas confluent; mesepisternum with a distinct episternal depression which is polished, impunctate, rest of episternum shining, with distinct punctures; sides of propodeum confluently punctate; recurrent interstitial in one wing, distinctly antefurcal in other. Black; band on apical margin of clypeus confluent with narrow line (dentate opposite antennae) from near top of eye, spot on cheeks, tegulae, scutellum and metascutellum, and apical margins of first, second, and third (interrupted medianly and laterally on third) tergites *reddish yellow;* legs black; apex of anterior coxae, spot on intermediate coxae, trochanters, anterior and intermediate femora beneath, four anterior tibiae and tarsi, basal half of posterior tibiae and posterior tarsi *yellowish;* antennae black, with a broad yellowish annulus beyond the middle; wings hyaline, slightly yellowish with the apical margin dusky; venation, including stigma, dark brown.

In the paratype the areola and petiolar area are distinctly separated and the yellow line on inner eye margins is interrupted below.

Type locality.—Mission, British Columbia. Described from two females.

Type.—Cat. No. 22173, U.S.N.M.

AROTES DECORUS (Say).

Acoenitus decorus SAY, Boston Journ. Nat. Hist., vol. 1, pt. 3, 1836, p. 248.—LECONTE, Edition of Say, vol. 2, 1859, p. 702.

Arotes decorus CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 164.

Type lost, neotype a female in the collection in the Academy of Natural Sciences, Philadelphia, bearing name label in Cresson writing and considered as "proxytype" by Viereck.

The color of the hind femora makes this species easily recognized. In the specimens examined the recurrent is always antefurcal and the areolation of the propodeum is fairly constant. Basal area nearly parallel-sided, its length and width subequal; areola separated

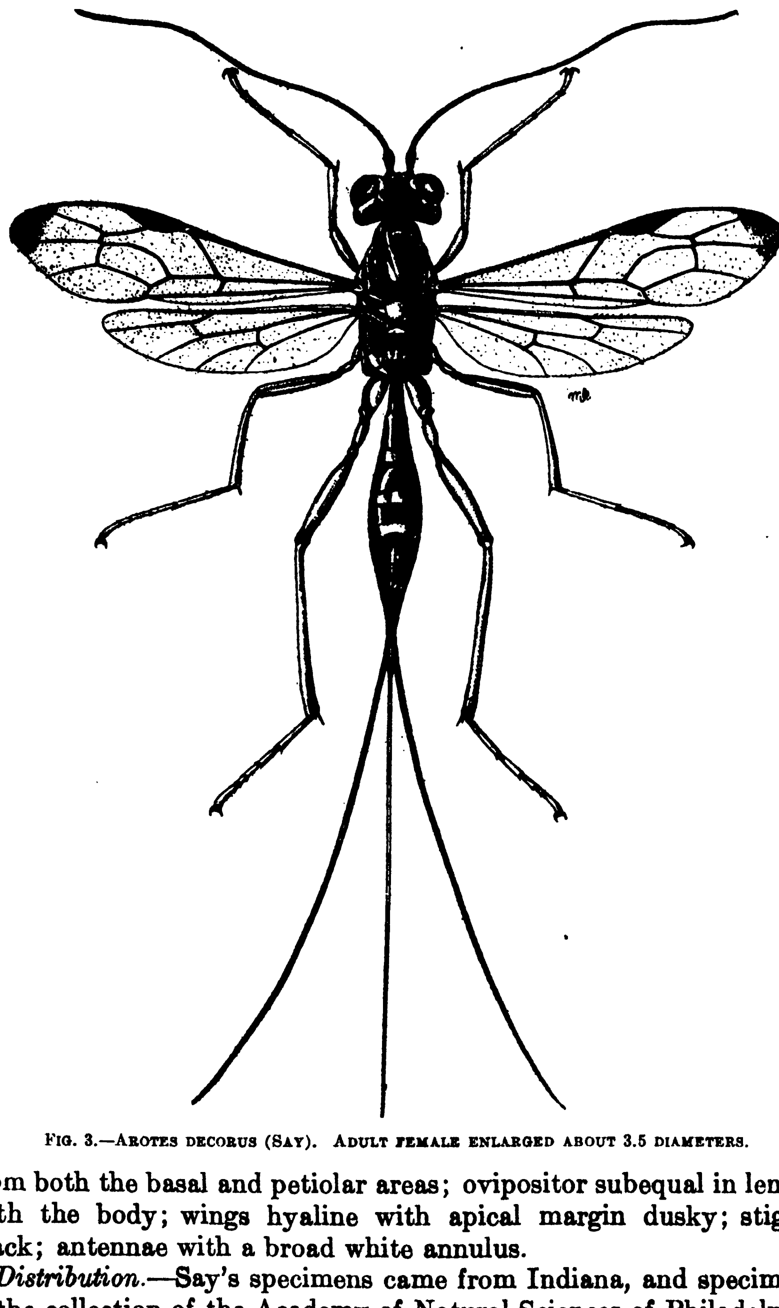


FIG. 3.—AROTES DECORUS (SAY). ADULT FEMALE ENLARGED ABOUT 3.5 DIAMETERS.

from both the basal and petiolar areas; ovipositor subequal in length with the body; wings hyaline with apical margin dusky; stigma black; antennae with a broad white annulus.

Distribution.—Say's specimens came from Indiana, and specimens in the collection of the Academy of Natural Sciences of Philadelphia

come from Virginia and Georgia. The national collection contains specimens from Cadet, Missouri; Milwaukee County, Wisconsin; Harrisburg and Linglestown, Pennsylvania (W. S. Fisher).

Hosts.—Felt [1] records this species as a parasite of *Xylotrechus colonus* Fabricius, and W. S. Fisher has reared it as a parasite of *Tomoxia bidentata* Say.

AROTES FORMOSUS Cresson.

Arotes formosus CRESSON, Can. Ent., vol. 1, 1868, p. 34.

Type a single male. Cat. No. 1435, Acad. Nat. Sci., Philadelphia.

This species although closely allied to *amoenus* is easily distinguished by the characters mentioned in the above key. Recurrent interstitial; ovipositor subequal in length with the body; wings hyaline with apical margin dusky; stigma black; notauli foveolate· antennae with a broad annulus.

Cresson's type came from Ottawa, Canada; there are two females from Massachusetts in the Academy of Natural Sciences of Philadelphia; and the National Collection has females from Sherbrook, Canada, and Floodwood, Schoolcraft County, Michigan (F. M. Gaige); and males from Clark's Valley, Dauphin, Pennsylvania, collected June 5, 1919, by Kirk and Champlain.

AROTES AMOENUS Cresson.

Arotes amoenus CRESSON, Can. Ent., vol. 1, 1868, p. 34.
Tropistes elegans PROVANCHER, Nat. Can., vol. 6, 1874, p. 80.

Type of *amoenus* Cat. No. 1434, Academy of Natural Sciences, Philadelphia. Type of *elegans* either lost or in Public Museum of Quebec under name label *amoenus*.

This is the commonest species of *Arotes* occurring in our fauna. The position of the recurrent in relation to the intercubitus is subject to considerable variation. It is often different in the two wings of the same specimen and varies from antefurcal by the length of the intercubitus to interstitial. The areolation of the propodeum is also subject to considerable variation, as the areola and basal area may each be either longer than wide or wider than long, and all intermediate conditions exist. The color is, however, fairly constant and the species should easily be recognized by the above key.

Distribution.—Specimens in the collection of the Academy of Natural Science of Philadelphia come from Canada, Virginia, Massachusetts, and Pennsylvania, while the National Collection contains specimens from the following localities: Sherbrook, Canada; Capens, Maine; Durham, New Hampshire (Weed and Fiske); east Massachusetts; Savoy, Massachusetts (W. E. Britton); Nassau (Bowditch), East River (C. R. Ely), Connecticut; New York; Pennsylvania; Castle Rock and Overbrook (G. M. Greene), Pennsylvania; Laurel (E. B.

[1] Forest and Shade Tree Insects of New York, vol. 1, 1905, p. 261.

Marshall), College Park (F. Knab), Maryland; Dead Run, Fairfax County, Virginia (Shannon); Black Mountains, North Carolina (N. Banks); Milwaukee County, Wisconsin; Texas (Belfrage).

AROTES VICINUS Cresson.

Arotes vicinus CRESSON, Trans. Amer. Ent. Soc., vol. 2, 1869, p. 260.
Arotes venustus CRESSON, Trans. Amer. Ent. Soc., vol. 2, 1869, p. 260.
Arotes superbus PROVANCHER, Nat. Can., vol. 6, 1874, p. 81.

Type of *vicinus*, one male, Cat. No. 1432, Academy of Natural Sciences, Philadelphia. Type of *venustus*, two females (one type), Cat. No. 1433, Academy of Natural Sciences, Philadelphia. Type of *superbus*, not located, but probably in Public Museum, Quebec, unlabeled, under the name *vicinus*.

In describing *vicinus* Cresson did not specify the sex or number of specimens, but it is certain that he had only the male, and in the collection of the Academy of Natural Sciences in Philadelphia there is one male which was made lectotype by Cresson. This male is the opposite sex of the species described as *venustus*. The male originally associated with *venustus* represents a different species and should be known as *occiputalis*, a name suggested by Cresson.

Robust; ovipositor distinctly longer than the abdomen, but shorter than thorax and abdomen; recurrent usually interstitial, but in some specimens antefurcal; hind coxae rufous, with bases and apices black or black with rufous spots; wings subhyaline with the usual apical spot.

Distribution.—Massachusetts (Cresson); Quebec, Canada (Provancher); New York; Munsing, Michigan (H. B. Morris); Whitefish Point, Michigan (A. W. Andrews); Inglenook, Pennsylvania (Craighead); Brettell Mills, South Dakota (Hopkins); Falls Church, Virginia (Kirk).

Hosts.—Reared as a parasite of *Leptura vittata* by F. C. Craighead and from a pine stump containing *Leptura rubrica* and *L. vagans* by H. B. Kirk.

AROTES OCCIPUTALIS Cresson.

Arotes occiputalis CRESSON, Trans. Amer. Ent. Soc., vol. 2, 1869, p. 260.
Arotes apicatus DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1879, p. 366.

Type of *occiputalis*, two males (one type), Cat. No. 4001, Academy Natural Sciences, Philadelphia. Type of *apicatus*, one female, Cat. No. 164, Academy Natural Sciences, Philadelphia.

In describing *venustus* Cresson expressed a doubt as to the correct association of the male and suggested that the male he described was possibly "a distinct species, in which case it may be named *occiputalis*." The name *occiputalis* has therefore been omitted from most of the catalogues. The female described by Davis as *apicatus* is undoubtedly the female of *occiputalis*.

Rather slender; ovipositor shorter than the thorax and abdomen; hind coxae of female rufous to black; face of female usually black with orbital lines and a small central spot, but occasionally entirely yellow; mesepisternum usually black in female, but in one specimen with a yellow band; propodeum in female black, with the posterior face yellow; thorax of male largely yellow; recurrent interstitial or antefurcal.

Distribution.—West Virginia (Cresson); Michigan (Davis); Delaware Water Gap, New Jersey; Jackson's (P. R. Myers), Cabin John Bridge (R. M. Fouts), Maryland; Great Falls (H. L. Viereck), Falls Church (Wm. Middleton), Springfield (T. E. Snyder), Virginia.

Host.—Reared as a larval parasite of *Strangalia bicolor* by T. E. Snyder.

GENERA NOT REPRESENTED IN NORTH AMERICAN FAUNA.

Apparently the three genera, *Mesoclistus* Foerster, *Acoenites* Latreille, and *Phaenolobus* Foerster, have not been discovered in North America. Specimens of the genotypes of all of these are in the National Museum collection and have been used in devising the key to genera. The features mentioned in the key are apparently so characteristic that further discussion of the genera individually is not necessary.

Chorischizus Foerster was synonymized by Roman [1] with *Phaenolobus* Foerster, in which he was undoubtedly correct. The only character by which these have been separated is the possession or lack of the ramulus—a character of not more than specific value. We have examined specimens of the genotypes of both genera and find no differences of generic value.

Apparently nothing is known of the host relations of *Mesoclistus* and *Acoenites*, and there is only one record referring to the host of *Phaenolobus*. Brischke recorded *Phaenolobus arator* (Rossi) as a parasite of *Sesia formicaeformis* Esper.

No North American species has ever been referred to *Mesoclistus* or *Phaenolobus*, but several have been described in *Acoenites*. These are listed below and their proper systematic position is indicated.

SPECIES ERRONEOUSLY REFERRED TO ACOENITES.

Acoenites canadensis PROVANCHER, Nat. Can., vol. 12, 1880, p. 10, male.

Acoenites flavipes PROVANCHER, Nat. Can., vol. 6, 1874, p. 80, female.

Mr. Rohwer has examined the types of the above two species. He pronounces them to be species of *Coleocentrus*, and *canadensis* to be the male of *flavipes*. The two species are thus treated on page 507 of this paper.

Acoenites decorus SAY, Bost. Journ. Nat. Hist., vol. 1, 1836, p. 248, male and female.

Referred by Cresson[2] to *Arotes* (see p. 517).

[1] Ent. Tidsk., 1910, p. 184.

[2] Trans. Amer Ent. Soc., vol. 4, 1872, p. 164.

Acoenites melleus **SAY, Bost. Journ. Nat. Hist., vol. 1. 1836, p. 249, female.**

This is an *Arotes*, (see p. 516).

Acoenites rupinsulinsis CRESSON, Trans. Amer. Ent. Soc., vol. 3, 1870, p. 143; WALSH, Trans, St. Louis Acad. Sci., 1873, p. 152.

This is also an *Arotes*, (see p. 516).

Acoenites stigmapterus SAY, Keating's Narrat. Exped., vol. 2, 1824, App. p. 325, female.

Walsh referred this to *Xylonomus*. It more properly belongs to *Xorides*.[1]

HOST CATALOGUE.

Cerambycid in Viburnum.

Coleocentrus minor Cushman.

Leptura rubrica Say or **Leptura vagans** Olivier.

Arotes vicinus Cresson.

Leptura vittata Germar.

Arotes vicinus Cresson.

Sesia formicaeformis Esper.

Phaenolobus arator (Rossi).

Strangalia bicolor Swederus.

Arotes occiputalis Cresson.

Tomoxia bidentata Say.

Arotes decorus (Say).

Xylotrechus colonus Fabricius.

Arotes decorus (Say).

[1] See Proc. U. S. Nat. Mus., vol. 57, 1920, p. 444.

INDEX.

This index includes the names of all the genera and species treated in this paper. Accepted genera are in bold face type; synonyms in italics; valid species in Roman.

A NEW FRESH-WATER MOLLUSK FROM INDIANA.

By Bryant Walker,
Of Detroit, Michigan.

Among the collections of Ancylids made in Lake Maxinkuckee, Indiana, by Dr. Paul Bartsch, is a new species of *Ferrissia*, which is here described and figured.

FERRISSIA BARTSCHI, new species.

Shell small, very much depressed, regularly oval, the left margin being only slightly more curved than the right, regularly rounded at both ends; apex prominent, blunt, rounded, situated on the posterior third of the shell, slightly turned to the right; apical striae conspicuous; lines of growth fine and regular; anterior slope nearly straight, but oblique, curving down more rapidly as it approaches the anterior margin. Irregularly radiately striate; posterior slope straight below the swell of the apex; left slope convex, slightly flattened towards the apex; right slope nearly straight.

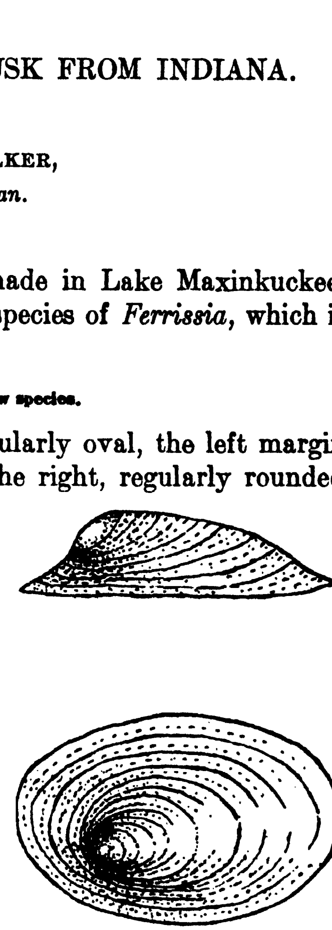


Fig. 1.—Ferrissa bartschi, new species.

Length 2.5, width 1.5, alt. 5 mm.

Type.—Cat. No. 334709, U.S.N.M., from a marsh at the south end of Lake Maxinkuckee, Indiana. Topotypes in Coll. Walker (No. 47087).

This diminutive species has only one near relative; namely, *Ferrissia novangliae* Walker. It differs from this in its smaller size and more depressed shape, more regularly oval outline, less eccentric apex, which projects more conspicuously above the transverse outline of the shell and in the degree of postulation of the anterior slope.

SYNOPSIS OF THE TREMATODE FAMILY HETEROPHYIDAE WITH DESCRIPTIONS OF A NEW GENUS AND FIVE NEW SPECIES.

By Brayton Howard Ransom,
Assistant Custodian, Helminthological Collections, United States National Museum.

The family Heterophyidae is composed of a number of genera of small flukes, parasitic in the intestine of mammals and birds, usually fish eaters. The family is of considerable interest in human and veterinary medicine as several species are of more or less common occurrence in man, dog, or cat. The following genera may be recognized as belonging to this family: *Heterophyes* Cobbold, 1866; *Cryptocotyle* Lühe, 1899; *Centrocestus* Looss, 1899; *Ascocotyle* Looss, 1899; *Apophallus* Lühe, 1909; *Pygidiopsis* Looss, 1907; *Metagonimus* Katsurada, 1913; a heretofore undescribed genus proposed in the present paper; and, provisionally, *Paracoenogonimus* Katsurada, 1914, a very imperfectly known genus possibly identical with *Cryptocotyle*. The following generic names in this family either fall as synonyms or are not to be recognized at present because the species upon which they are based are considered to belong to some of the genera of prior date:

Coenogonimus Looss, 1899 (type *heterophyes*), and *Cotylogonimus* Lühe, 1899 (type *heterophyes*) are both synonyms of *Heterophyes*. *Tocotrema* Looss, 1899 (type *lingua*), and *Hallum* Wigdor, 1918 (type *caninum*), are congeneric with the earlier *Cryptocotyle* Lühe, 1899 (type *concava*). *Tocotrema* and *Cryptocotyle* are based on different type species, but the differences in these do not appear sufficient to justify their generic separation, while *Hallum caninum* appears to be specifically identical with *Cryptocotyle lingua*. *Loossia* Ciurea, 1915 (type *romanica*), and *Yokogawa* Leiper, 1913 (type *yokogawa*= *yokogawai*), give way to *Metagonimus* Katsurada, 1913, Leiper's genus being based on the same type as *Metagonimus* and *Loossia* clearly having the characters of *Metagonimus*.

The genus *Scaphanocephalus* Jägerskiöld, 1903 (type and only known species *expansus*), has been considered by some authorities

to belong with the genera listed above, but is quite different from them in respect to the size of the body, *S. expansus* measuring 5 mm. or more in length, all of the other known members of the family being flukes less than 2 mm. in length, or in a few instances slightly exceeding this size. Furthermore the testes of *S. expansus* are distinctly median in position, one directly behind the other, very deeply lobed; the ovary is also much lobed, and the uterus voluminous, in all of which characters it differs from the Heterophyidae. *Scaphanocephalus* on the other hand resembles some of the Heterophyidae in the possession of a genital sucker in close relation with the ventral sucker, and in the arrangement of the vitellaria, and like all of them lacks a cirrus pouch. The similarities of *Scaphanocephalus* to the Heterophyidae, however, do not appear sufficient to justify its inclusion in this family.

Specimens of flukes belonging to the Heterophyidae that have recently come to the writer's attention have been found to represent a number of species as follows: Two new species of *Ascocotyle* from the fox (*Vulpes lagopus*); a new species of *Apophallus* from a gull (*Larus delawarensis*); *Cryptocotyle lingua* from the harbor seal (*Phoca vitulina*), for comparison with which some of the type specimens of *Hallum caninum* from the dog (=*C. lingua*) have been available through the courtesy of Parke, Davis and Co.; and two new species representing a new genus—one from the cat, dog, and fox, and the other from the harbor seal.

Family HETEROPHYIDAE Odhner, 1914.

Family diagnosis.—Fascioloidea: Small and very small forms usually not over 2 mm. long, rarely slightly longer, not exceeding 5 mm. in length. Anterior portion of body in front of ventral sucker thinner, more slender and more movable than the posterior portion. Surface of body thickly covered with small thin backward projecting scales that become reduced posteriorly and may entirely disappear toward the posterior end of the body. Intestinal ceca simple tubular sacs, commonly extending nearly to the posterior end of the body, running parallel with the lateral borders and not far removed from them throughout most of their course. Genital pore in the immediate neighborhood of the ventral sucker. Genital sucker may be present. Ventral sucker usually median, but may be displaced to the right of the median line. No cirrus pouch. Vas deferens and vagina with a common opening. Testes oval, globular, or slightly lobed, near the posterior end of the body, side by side, or obliquely one in front of the other. Seminal vesicle well developed, U- or S-shaped, the vas deferens surrounded proximally with a mass of pros-

tatic cells, and extending from the anterior limb of the seminal vesicle to the genital opening. Ovary oval, globular, or slightly lobed, median, or usually on the right, rarely on the left, of the median line, anterior of the testes. Seminal receptacle and Laurer's canal present, near the ovary, usually in relation with its posterior border. Vitellaria, located mainly in the lateral fields in the posterior end of the body, may extend anteriorly to or a short distance beyond the level of the ventral sucker, and may enter the median field and approach or extend to the median line in this region. Uterus arranged usually in a few transverse loops, but sometimes with numerous loops, limited to the region in front of the testes and behind the genital pore, except occasionally one or more loops may be present in front of the latter. Eggs usually not very numerous, from 15 to 50 μ long, rarely (*Paracoenogonimus*) may exceed 100 μ in length. Adults parasitic in the intestine of mammals and birds.

Type genus.—*Heterophyes* Cobbold, 1866.

KEY TO GENERA.

1. Eggs not over 50μ long ---------- 2.
   Eggs over 100μ long ---------- *Paracoenogonimus*, p. 550.
2. Ventral sucker median ---------- 3.
   Ventral sucker and genital pore displaced to right of median line ---------- *Metagonimus*, p. 538.
3. Genital sucker present ---------- 4.
   Genital sucker absent ---------- 5.
4. Genital sucker median, directly posterior of the more or less rudimentary ventral sucker ---------- *Cryptocotyle*, p. 543.
   Genital sucker at one side of or obliquely behind the well-developed ventral sucker ---------- *Heterophyes*, p. 530.
5. Prepharynx long, pharynx usually nearer to the bifurcation of the intestine than to the oral sucker ---------- 6.
   Prepharynx short, pharynx much nearer to the oral sucker than to the bifurcation of the intestine ---------- 8.
6. Oral cecum present ---------- *Ascocotyle*, p. 561.
   Oral cecum absent ---------- 7.
7. Mouth surrounded by a crown of spines; vitellaria extend into the region in front of the ventral sucker ---------- *Centrocestus*, p. 559.
   Mouth not surrounded by a crown of spines; vitellaria limited to the region of the testes ---------- *Pygidiopsis*, p. 568.
8. Vitellaria commonly extend into the median field in front of ventral sucker, frequently meeting in the median line, with comparatively few lobules in the post-testicular region, these not crossing the median line, and not extending between the testes ---------- *Cotylophallus*, p. 554.
   Vitellaria usually strictly lateral in the anterior region, not extending inwards to the median line in front of the ventral sucker, but with numerous lobules behind, between and often dorsal and ventral of the testes ---------- *Apophallus*, p. 551.

Genus HETEROPHYES Cobbold, 1866.

Generic diagnosis.—Heterophyidae: Cuticular scales rectangular, longer than broad, length about 5 to 7.5 μ. Prepharynx short, pharynx nearer to the oral sucker than to the bifurcation of the intestine. Intestinal ceca extend into the posterior portion of the body reaching the level of or extending behind the testes. Ventral sucker median near the middle of the body. Genital pore surrounded by a genital sucker located near the ventral sucker at one side or obliquely behind it. Genital sucker armed with a circlet of curved chitinous rodlets, 25 to 80 in number; circlet more or less discontinuous on the side of the genital sucker toward the ventral sucker; rodlets about 10 to 20 μ long, with about 5 minute pointed processes in a row along the convex side. Testes globular or oval, situated side by side near the posterior end of the body right and left of the median line. Seminal vesicle well developed, U-shaped, behind the genital sucker. Ovary globular or ovoid, situated in front of the testes, median, or on the right of the median line. Seminal receptacle between testes and ovary. Vitellaria in the lateral fields in the posterior end of the body near the dorsal surface, not extending forward much beyond the level of the anterior border of the ovary. Coils of uterus in the region between the testes and the ventral sucker, none in front of the latter.

Type species.—*Heterophyes aegyptiaca* Cobbold, 1866 (=*Distoma heterophyes* Siebold, 1852, renamed).

The flukes of the genus *Heterophyes* in all probability occur in their immature stages in fish, the adults having been found thus far only in fish-eating birds and mammals, including man, this opinion being based on the fact that related flukes in the family Heterophyidae are known to have immature stages in fish.

It appears questionable whether all of the species of *Heterophyes* that have been described are really distinct, but the writer has followed Looss (1902*n*) in recognizing seven species. It seems not unlikely, however, that Looss has carried the process of separating species beyond the limits of practicability and it is doubtful whether some of the species described by him can readily be distinguished from others, at least in the case of individual specimens.

KEY TO SPECIES.

1. Length 3 mm. or more; vitellaria dorsally extending inwards nearly to the borders of the ovary __ *Heterophyes persicus.*
   Length not over 2 mm.; vitellaria limited to lateral fields __________ 2.
2. Length usually greater than 0.9 mm.; vitellaria with about 14 lobules in each lateral field extend as far forward as the level of the anterior

border of the ovary; chitinous rodlets of genital sucker 70 to 80 in number; eggs about 30 μ long	(heterophyes group) — 3.
Length usually less than 0.9 mm. may reach 1 mm.; vitellaria with 10 to 12 lobules in each lateral field extend only as far forward as the level of the posterior border of the ovary; chitinous rodlets of genital sucker 25 to 75 in number; eggs about 20 μ long	(fraternus group) — 4.
3. Length 1 to 1.7 mm.; eggs light brown; in man, dog, cat, and (?) fox	*Heterophyes heterophyes.*
Length 0.75 to 0.95 mm.; eggs bright yellow; in *Milvus aegyptius*	*Heterophyes pallidus.*
4. Cuticular scales relatively long and narrow, very close together; chitinous rodlets of the genital sucker 65 to 75 in number; in *Pelecanus onocrotalus*	*Heterophyes fraternus.*
Cuticular scales relatively broad and coarse with rather wide intervals between them; chitinous rodlets of the genital sucker 25 to 35 in number	5.
5. Oral, ventral, and genital suckers not greatly different in size; intestinal ceca do not extend beyond the posterior borders of the testes	6.
Ventral sucker much larger than the others, 2 to 3 times the diameter of the oral sucker; intestinal ceca reach posterior borders of testes, sometimes reaching excretory vesicle; eggs a deep dark brown in color; in dog and cat	*Heterophyes dispar.*
6. Maximum length 0.46 mm.; free edges of cuticular scales ending in a number of very fine points; ventral sucker about 56 μ in diameter; color of eggs never darker than a light yellowish-brown; in *Pelecanus* and *Milvus*	*Heterophyes inops.*
Maximum length 0.5 to 0.9 mm.; ventral sucker 70 to 90 μ in diameter; color of eggs a bright brown; in cat and dog	*Heterophyes aequalis.*

HETEROPHYES HETEROPHYES (Siebold, 1852) Stiles and Hassall, 1900.

Figs. 1, 2.

1852. *Distoma heterophyes* Siebold 1852*f*, pp. 62–64, pl. 5, figs. 16–17 (in Homo; Egypt).

1855. *Distoma heterophyes hominis* Diesing, 1855*c*, p. 64.

1858. *Dicrocoelium heterophyes* (Siebold, 1852) Weinland, 1858*a*, p. 86.

1860. *Fasciola heterophyes* (Siebold, 1852) Moquin-Tandon, 1860*a*, p. 347.

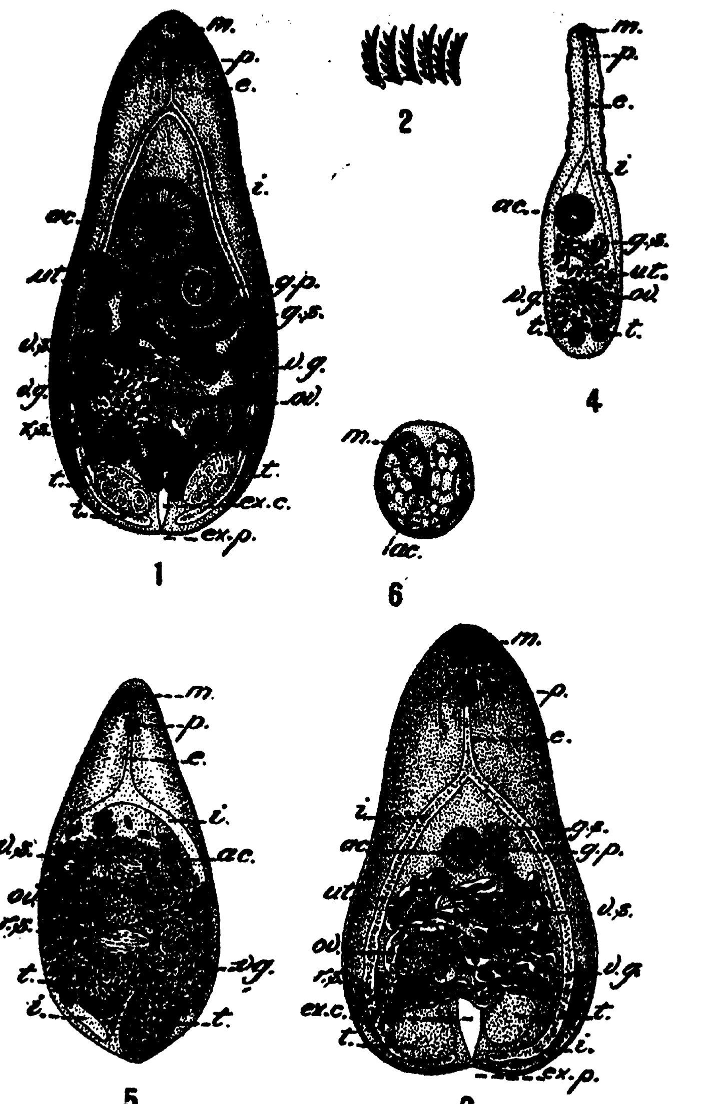
1866. *Heterophyes aegyptiaca* Cobbold, 1866*a*, p. 6 (type of *Heterophyes; Distoma heterophyes* renamed).

1890. *Mesogonimus heterophyes* (Siebold, 1852) Railliet, 1890*w*, p. 143.

1899. *Coenogoninmus heterophyes* (Siebold, 1852) Looss, 1899*b*, pp. 585, 586, 619 (type of *Coenogonimus*).

1899. *Cotylogonimus heterophyes* (Siebold, 1852) Lühe, 1899*k*, p. 539 (type of *Cotylogonimus*).

1900. *Heterophyes heterophyes* (Siebold, 1852) Stiles and Hassall, 1900*a*, p. 563.



FIGS. 1–6.[1] 1.—HETEROPHYES HETEROPHYES. VENTRAL VIEW. × 40. AFTER LOOSS, 1896. 2.—HETEROPHYES HETEROPHYES. CHITINOUS RODLETS OF GENITAL SUCKER. × 525. AFTER LOOSS, 1896. 3.—HETEROPHYES FRATERNUS. VENTRAL VIEW. × 128. AFTER LOOSS, 1896. 4.—HETEROPHYES PERSICUS. VENTRAL VIEW. × 17. AFTER BRAUN, 1901. 5.—METAGONIMUS YOKOGAWAI. DORSAL VIEW OF ADULT FROM DOG. × ABOUT 75. AFTER YOKOGAWA, 1913. 6.—METAGONIMUS YOKOGAWAI. ENCYSTED CERCARIA FROM SCALE OF FISH. × ABOUT 100. AFTER YOKOGAWA, 1913. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE.]

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[1] EXPLANATION OF LETTERING USED IN ILLUSTRATIONS.

ac., ventral sucker. *ap.*, appendix. *e.*, esophagus. *ex. c.*, excretory canal or vesicle. *ex. p.*, excretory pore. *g. c.*, opening of genital canals. *g. p.*, genital pore. *g. s.*, genital sucker. *i.*, intestinal ceca. *l.*, dorsal lip. *l. b.*, lenticular body. *m.*, mouth with oral sucker. *o. c.*, oral cecum. *ov.*, ovary. *p.*, pharynx. *p. p.*, prepharynx. *pr.*, prostatic portion of vas deferens. *r. s.*, seminal receptacle. *t.*, testis. *ut.*, uterus. *v. d.*, vas deferens. *v. e.*, vas efferens. *v. g.*, vitellaria. *v. s.*, seminal vesicle.

Specific diagnosis.—Heterophyes: Length, 1 to 1.3 mm.; breadth 0.6 mm. or over (specimens fixed in corrosive sublimate without shaking), or length 1.6 to 1.7 mm., width 0.3 to 0.4 mm. (specimens fixed in corrosive sublimate or alcohol, shaken during fixation). Cuticular scales relatively narrow, close together. Ventral sucker very muscular and thick-walled, two and one-fourth to two and three-fourths, genital sucker about one and one-half, times as large as the oral sucker. Average diameter of oral sucker, 90 µ; of ventral sucker, 230 µ; of genital sucker, 150 µ. Chitinous rodlets of genital sucker, 70 to 80 in number. Intestinal ceca slender, ends passing behind the testes and terminating near the excretory vesicle. Vitellaria consisting of about 14 lobules in each lateral field extend forward to about the level of the anterior border of the ovary. Lateral ends of the vitellaria viewed from the ventral side visible beyond the intestinal ceca, and some of the lobules often appear to curve around them toward the ventral side. Eggs light brown; about 30 µ by 17 µ.

Hosts.—Man; dog; cat; (?) fox.

Location.—Small intestine and cecum.

Localities collected.—Egypt, Japan, China.

According to Looss (1902*n*) all the specimens of *Heterophyes* from man examined by him belong to this species, also it is the usual species of *Heterophyes* found in the dog and occurs in this host in very large numbers, while in the cat it rarely occurs and usually in small numbers. As to the occurence of *H. heterophyes* in the fox he is uncertain. Specimens of flukes collected from a fox and determined to be *Coenogonimus heterophyes* by Looss (1899*b*) were afterwards lost, and it is not possible to affirm whether or not they should be placed in *H. heterophyes sensu stricto.* Looss (1902*n*) recognizes a socalled *sentus*-form of *H. heterophyes* which is relatively rare in the dog, the cat apparently being the usual host, in several cases hundreds of flukes all belonging to this form being present. The largest well-stretched individuals of this form are 1.4 mm. long, 0.4 mm. wide; usual length 0.9 to 1.1 mm., breadth 0.3 to 0.5 mm. Ventral sucker about twice as large as the oral sucker, in young individuals somewhat less, in old individuals somewhat more, than twice as large. Genital sucker about equal in size to the ventral sucker, only in old individuals about one-fifth smaller. Average diameter of oral sucker 73 µ, of ventral sucker 146 µ, of genital sucker 112 µ. Eggs bright yellowish brown in color, brighter than those of *H. heterophyes.*

HETEROPHYES PALLIDUS Looss, 1902.

1902. *Heterophyes pallidus* Looss, 1902 *n*, pp. 889–890 (in *Milvus aegyptius*; Egypt).

Specific diagnosis.—Heterophyes: Maximum length of extended individuals 0.95 mm., breadth 0.38 mm.; average length of greatly

contracted individuals 0.75 to 0.8 mm., breadth 0.4 to 0.5 mm. Cuticular scales relatively narrow, close together. Ventral sucker always twice or more than twice (two to two and one-fourth times) the size of the oral sucker. Genital sucker about two-thirds the diameter of the ventral sucker. Average diameter of oral sucker, 62 μ; of ventral sucker, 150 μ; of genital sucker, 104 μ. Chitinous rodlets of genital sucker, 70 to 80 in number. Vitellaria, consisting of about 14 lobules in each lateral field, extend forward to about the level of the anterior border of the ovary. Eggs bright yellow in color, about 30 by 17 μ.

Host.—*Milvus aegyptius* (=*M. parasiticus*).

Location.—Small intestine.

Locality collected.—Egypt.

This species formerly included in *H. heterophyes* was separated from it by Looss (1902*n*) on account of certain differences in the relative dimensions of the suckers, and the color of the eggs.

HETEROPHYES FRATERNUS (Looss, 1894) Looss, 1902.

FIG. 3.

1894. *Distomum fraternum* LOOSS, 1894*d*, pp. 42–48, pl. 2, figs. 13–15 (in *Pelecanus onocrotalus*; Egypt).

1899. *Coenogonimus fraternus* (LOOSS, 1894) LOOSS 1899*b*, pp. 585, 700–701.

1901. *Cotylogonimus fraternus* (LOOSS, 1894) BRAUN, 1901*e*, p. 337.

1902. *Heterophyes fraternus* (LOOSS, 1894) LOOSS 1902*m*, pp. 785, 808, 809, 838, 854.

Specific diagnosis.—*Heterophyes:* Largest most extended individuals nearly 0.6 mm. long, usually 0.4 to 0.5 mm. and about 0.3 mm. wide. Cuticular scales relatively long and narrow, very close together. Ventral sucker and genital sucker almost equal in size in young individuals, and somewhat larger than the oral sucker, in older individuals the ventral sucker being larger than the genital sucker. Average diameter of oral sucker, 50 μ; of ventral sucker, 70 μ; of genital sucker, 60 μ. Chitinous rodlets of the genital sucker 65 to 75 in number, the circlet presenting the appearance of a fine comb or brush in certain stages of contraction of the sucker. Intestinal ceca always extend behind the testes and terminate near the wall of the excretory vesicle. Vitellaria consisting of 10 to 12 lobules in each lateral field extending forward only as far as the level of the posterior border of the ovary. Eggs about 20 by 10 μ in diameter, shell about 1 μ thick; color never darker than a light yellowish-brown.

Host.—*Pelecanus onocrotalus.*

Location.—Small intestine.

Locality collected.—Egypt.

HETEROPHYES INOPS Looss, 1902.

1902. *Heterophyes inops* Looss 1902n, pp. 887–888 (in *Pelecanus onocrotalus*; Egypt).

Specific diagnosis.—Heterophyes: Largest mature individuals 0.46 mm. long. Cuticular scales relatively short and broad with their free edges terminating in a number of very fine points; arranged, especially on the ventral surface of the body, with rather wide intervals between them. Ventral sucker a little larger, the genital sucker in its retracted condition a little smaller, than the oral sucker. Oral sucker, 46 μ; ventral sucker, 56 μ; genital sucker, 36 μ in average diameter. Chitinous rodlets of the genital sucker 25 to 35 in number, rather widely separated from one another. Intestinal ceca usually rather wide, normally extend only as far as the anterior borders of the testes, but may reach nearly to their posterior borders, never beyond them. Vitellaria consisting of 10 to 12 lobules in each lateral field extending forward only as far as the level of the posterior border of the ovary, and limited to the dorsal portion of the body near the surface. Eggs about 20 by 10 μ in diameter, shell about 1 μ thick; color never darker than a light yellowish-brown.

Hosts.—Pelecanus onocrotalus; Milvus aegyptius (=*M. parasiticus*).

Location.—Small intestine.

Locality collected.—Egypt.

This species originally included in *H. fraternus* was separated from it by Looss (1902n) because of slight differences in the cuticular scales, extent of the intestinal ceca, relative dimensions of the suckers, and number of chitinous rodlets in the genital sucker.

HETEROPHYES AEQUALIS Looss, 1902.

1902. *Heterophyes aequalis* Looss, 1902n, p. 888 (in cat and dog; Egypt).

Specific diagnosis.—Heterophyes: Largest individuals 0.9 mm. long. Average size 0.5 to 0.7 mm. long by 0.3 to 0.4 mm. wide. Cuticular scales relatively broad and coarse, rather widely separated. Oral sucker and genital sucker almost equal in size, diameter varying in mature individuals between 50 and 60 μ. Ventral sucker somewhat larger, varying between 70 and 90 μ in diameter according to age. Chitinous rodlets of genital sucker 25 to 35 in number, rather widely separated from one another. Intestinal ceca end between the levels of the anterior and posterior borders of the testes, frequently at somewhat different levels on the two sides. Vitellaria only near the dorsal surface of the body, lobules very compact, 10 to 12 in each lateral field, extending forward only as far as the level of the posterior border of the ovary. Eggs about 20 by 10 μ

in diameter, with shell about 1 μ thick; their color in anterior portions of uterus a bright brown, and even in very young individuals with a few eggs, the color is deeper than in *H. inops*.

Hosts.—Cat (apparently the usual host); dog (common in this host, but in small numbers).

Location.—Small intestine.

Locality collected.—Egypt.

This species like *H. inops* was formerly included in *H. fraternus*, but separated from it by Looss (1902*n*) because of differences in the cuticular scales, extent of the intestinal ceca, relative dimensions of the suckers, and number of chitinous rodlets in the genital sucker. It is a somewhat larger species than *H. inops;* the ventral sucker is considerably larger, and the eggs are deeper in color.

HETEROPHYES DISPAR Looss, 1902.

1902. *Heterophyes dispar* Looss, 1902*n*, pp. 888–889, 890, 891 (in dog and cat; Egypt).

Specific diagnosis.—*Heterophyes:* Average length, 0.8 to 0.9 mm., may reach 1 mm. in old fully grown individuals; breadth, 0.3 to 0.4 mm. Cuticular scales very large, and separated from one another by relatively wide intervals even as far forward as the middle of the body. Oral sucker and genital sucker almost equal in size. Ventral sucker very large; in young individuals about twice, in old individuals almost three times, as large as the oral sucker. Average diameter of oral sucker, 68 μ; of ventral sucker, 168 μ (transverse) and 146 μ (longitudinal); of genital sucker, 72 μ. Chitinous rodlets of genital sucker about 30 in number, separated by rather wide intervals. Intestinal ceca reach the posterior borders of the testes and may extend as far as the wall of the excretory vesicle. Vitellaria consisting of 10 to 12 lobules in each lateral field, extending forward only as far as the level of the posterior border of the ovary. Eggs about 20 μ by 10 μ in diameter; shell about 1 μ thick; color of mature eggs a deep dark brown.

Hosts.—Dog (of common occurrence in this host); cat (occasional host; occurs in small numbers in this host).

Location.—Small intestine.

Locality collected.—Egypt.

Heterophyes dispar was formerly included in *H. fraternus*, but Looss (1902*n*) separated it from this species because of its larger size, coarser cuticular scales, its very large ventral sucker, small number of chitinous rodlets in the genital sucker, and much browner color of the eggs. Looss (1902*n*) recognizes a *limatus*-form of *H. dispar* found once in the intestine of a cat in Egypt, 23 specimens being collected. This form is more slender than the usual specimens of *H. dispar*, measuring 0.85 mm. long by 0.2 to 0.25 mm. wide. The

ventral sucker, instead of two to three times as large as the oral sucker, is only one-half to three-fourths larger. Average diameter of oral sucker, 50 μ; ventral sucker, 80 μ; genital sucker, 46 μ. Eggs dark brown, but somewhat lighter than those of *H. dispar*.

HETEROPHYES PERSICUS (Braun, 1901) Looss, 1902.

Fig. 4.

1901. *Cotylogonimus persicus* BRAUN, 1901e, pp. 334–338, pl. 20, fig. 13 (in Persian wolf; Germany).

1902. *Heterophyes persicus* (Braun, 1901) LOOSS, 1902m, pp. 782, 785.

Specific diagnosis.—Heterophyes: Length, 3 to 4 mm.; maximum width, 0.8 to 0.9 mm. Oral sucker globular, 104 μ in diameter, or transversely elongated, 73 by 104 μ. Prepharynx rather long but shorter than the esophagus. Pharynx almost globular, 62 μ long by 53 μ wide. Bifurcation of intestine in front of the ventral sucker a distance about equal to its diameter. Intestinal ceca end near the excretory vesicle. Ventral sucker near the boundary between the middle and posterior thirds of the body, 375 to 416 μ in diameter. Genital sucker, about 250 μ in diameter, on the left side of and obliquely behind the ventral sucker, usually circular, occasionally somewhat broader than long. Crown of chitinous rodlets interrupted on the side of the genital sucker toward the ventral sucker. Rodlets slightly curved, supplied with 4 to 6 small pointed processes directed toward the free end of the rodlet, this free end being turned toward the center of the sucker. The pointed processes of the rodlet at the same time, however, lie in a plane perpendicular to the surface of the sucker. Number of rodlets 62 to 70; length nearly uniform, 9 to 10.4 μ; those near the interrupted portion of the crown always a little shorter than the others. Testes elliptical, left testis sometimes somewhat more anterior than right testis, about 200 by 160 μ in diameter. Ovary, 145 μ in diameter, in median line in front of testes. Seminal receptacle not apparent, coils of uterus filling space between testes and ovary. Vitellaria only weakly developed; as viewed from ventral surface appear to consist of 6 to 9 lobules on each side, extending from the level of the anterior border of the ovary to the level of the middle of the testes. As viewed from the dorsal surface the vitellaria are seen to consist of about 12 to 18 lobules on each side, since they push inwards between the coils of the uterus almost to the ovary. Most of the space between the testes and ventral sucker occupied by the uterus. Behind the ventral sucker a small globular organ belonging to the male copulatory apparatus. Mature eggs thick-shelled, dark brown, 22.8 μ long, 14 μ wide.

Host.—Persian wolf.

Location.—Intestine.

Locality collected.—Germany (Berlin Zoological Garden).

Genus METAGONIMUS Katsurada, 1913.

Generic diagnosis.—Heterophyidae: Prepharynx short; pharynx much nearer to the oral sucker than to the bifurcation of the intestine. Intestinal ceca extend into the posterior portion of the body, reaching the level of the posterior testis or extending behind it. Ventral sucker near the right side of the body near the right intestinal cecum, near or in front of the middle of the body. Genital sinus immediately in front of the ventral sucker and opening to the exterior in common with the latter through the genital pore. Testes globular or oval, in posterior end of body, right testis obliquely behind the left. Seminal vesicle well developed, retort-shaped, located to the left of and behind the ventral sucker. Ovary oval or globular, median in location, a short distance in front of the anterior testis. Seminal receptacle behind or to the right of the ovary. Vitellaria consist of a few rather large lobules located in the lateral fields and dorsal of the intestinal ceca and extending from the level of the anterior border of the ovary into the post-testicular region, but not crossing the excretory vesicle. Uterus with rather numerous coils occupies most of the posterior portion of the body between the testes and the level of the genital sucker. Eggs about 30 µ in length.

Type species.—*Metagonimus yokogawai* (Katsurada, ?1912) Katsurada, 1913.

METAGONIMUS YOKOGAWAI (Katsurada, ? 1912) Katsurada, 1913.

Figs. 5–10.

?1912. *Heterophyes yokogawai* KATSURADA, ?1912 (adults in man, dog, and other mammals; immature stage in *Plecoglossus altivelis;* Formosa).

1913. *Metagonimus yokogawai* (Katsurada) KATSURADA, 1913 in YOKOGAWA, 1913 (May), pp. 49–77, 1 pl., figs. 1–15; summary in German, pp. 3–4.

1913. *Yokogawa yokogawa* (Katsurada, ?1912) LEIPER, 1913 (July), pp. 282–285, fig. 31 (type of *Yokogawa;* misprint for *Yokogawa yokogawai*).

1913. *Tocotrema yokogawa* (Katsurada, ?1912) LEIPER, 1913, p. 282 (misprint for *Tocotrema yokogawai*).

1913. *Metagonimus ovatus* YOKOGAWA, 1913, pp. 45–49, 1 pl., figs. 1–2 (?host; ?Japan).

1915. *Loossia romanica* CIUREA, 1915, pp. 446–453, pl. 1, figs. 1–3 (type of *Loossia;* in dog; Roumania).

1915. *Loossia parva* CIUREA, 1915, pp. 453–454, pl. 1, fig. 4 (in cat; Roumania).

1915. *Loossia dobrogiensis* CIUREA, 1915, p. 454 (in *Pelecanus onocrotalus;* Roumania)

Specific diagnosis.—*Metagonimus:* Length from a minimum of about 0.35 mm. up to a maximum of 2.5 mm., commonly 1 to 1.5 mm.; width, 0.24 to 0.73 mm. Cuticular scales, 9 to 10 μ long by about 5 μ wide. Oral sucker, 48 to 110 μ in diameter. Prepharynx may reach a length of 74 μ in the extended condition. Pharynx 29 to 63 μ long by 22 to 52 μ wide. Esophagus considerably longer than the prepharynx, may reach a length of 143 μ. Ventral sucker placed with its long axis diagonal with reference to the longitudinal axis of the body, its posterior end deflected to the right, 66 to 165 μ long by 55 to 114 μ wide. In relation with the genital sinus and ventral sucker a crescentic muscular body or appendix somewhat similar to the genital papilla in the genital sinus of *Cryptocotyle.* Testes reach a maximum diameter of about 280 μ. Ovary 67 to 145 μ long by 67 to 165 μ wide. Seminal receptacle commonly somewhat larger than the ovary. Vitellaria consist of about 10 lobules in each lateral field. Eggs 27.5 to 30 μ long by 15 to 17 μ wide, yellowish-red, yellowish-brown, or dark brown in color.

Immature stage (encysted cercaria).—On the ovary in oval cysts 140 to 160 μ long by 100 to 120 μ wide; on the scales and in muscles in usually round cysts 126 to 160 μ in diameter; on the fins and tail in round cysts enclosed in an outer membrane 40 μ or more in thickness; diameter over all, about 224 μ. Larva covered by small spines; suckers and intestine visible; excretory vesicle very prominent. Removed from capsule, larva measures in fresh condition 0.4 to 0.47 mm. long. Ventral sucker smaller than oral sucker. Intestinal ceca extend to the posterior end of the body. Excretory vesicle containing numerous highly refractile granules occupies most of the space between the intestinal ceca. Genital organs undeveloped. When ingested by final host immature fluke develops to adult containing eggs in 4 to 5 days, oviposition beginning in 7 to 10 days after ingestion.

Hosts.—Man; dog; cat; pig; pelican (*Pelecanus onocrotalus*); mouse (experimental infections). Immature stages encysted in fishes (*Plecoglossus altivelis; Carassius auratus; Leuciscus hacuensis; Scardinius erythrophthalmus; Abramis brama; Esox lucius; Carassius carassius; Aspius aspius; Idus idus; Blicca björkna*).

Location.—Small intestine. (Immature stages in fresh-water fishes encysted in ovary, muscles, fins, tails, or on the scales.)

Localities collected.—Formosa; Japan; Korea; Roumania.

Leiper (1913) proposed the genus *Yokogawa* with Katsurada's species as type, but as his paper was not published until July the name is antedated by *Metagonimus*, which was published in May of the same year.

In addition to his papers on *M. yokogawai*, Yokogawa (1913, pp. 45–49, 3–4) has published another paper on *Metagonimus*, in which

he describes a second species, *M. ovatus* (fig. 7). This paper is in Japanese. A brief summary is given in German, in which it appears that *M. ovatus* differs from *M. yokogawai* in being oval in shape and smaller in size. These differences, in the opinion of the present writer, are insufficient to justify the separation of the two forms, and *M. ovatus* accordingly has been listed among the synonyms of *M. yokogawai*. It is not evident from what species of host animal *M. ovatus* was obtained. Presumably it was found in Japan.

Ciurea (1915) without knowledge of Yokogawa's work described the genus *Loossia* with three species based on flukes occurring in Rou-

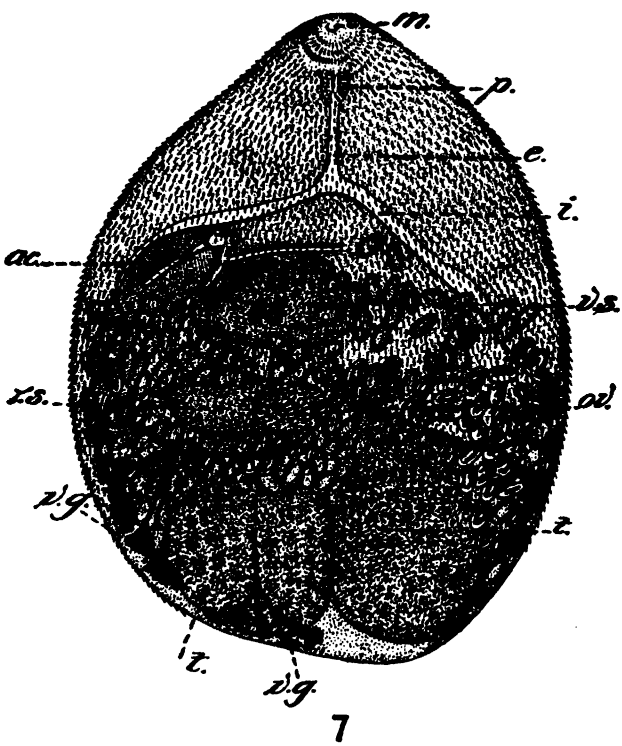


FIG. 7.—METAGONIMUS OVATUS (=M. YOKOGAWAI). VENTRAL VIEW. × ?. AFTER YOKOGAWA, 1913. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

mania. In a later article (1915) he called attention to the close resemblance between *Loossia* and *Metagonimus* and the possible identity of the two genera, although he considered it questionable whether both should not be recognized in view of certain discrepancies between Yokogawa's description and his own findings. In the present writer's opinion, however, the two genera are not distinguishable, and furthermore it does not appear that in practice the various species that have been described could be distinguished from one another.

As described by Yokogawa (1913) the adult *M. yokogawai* in the living condition measured 1 to 1.5, seldom 2.5, mm. long by 0.425 to 0.73 mm. wide. Oral sucker, 77 to 86.4 μ in diameter. Pharynx, 50.4 to 52.4 μ long by 45 to 52 μ wide. Ventral sucker, 120 to 136.8 μ long by 84.8 to 108 μ wide. Ovary, 120 to 132 μ in diameter. Testes, 210 to 280 μ in transverse diameter. Preserved specimens measured 0.56 to 0.982 mm. long by 0.35 to 0.526 mm. wide. Oral sucker, 48 to 62.4 μ in diameter. Pharynx, 28.8 to 36 μ long by 24 to 35.5 μ wide. Ventral sucker, 88.8 to 129.2 μ long by 55.2 to 60 μ wide. Ovary, 67.2 to 96 μ in diameter. Testes, 120 to 156 μ in transverse diameter. The cuticular scales measured 9.6 to 10 μ long in fully developed adults, and were described as nail-shaped. The eggs measured 27.5 to 30 μ long by 15 to 16.8 μ wide; color yellowish-brown.

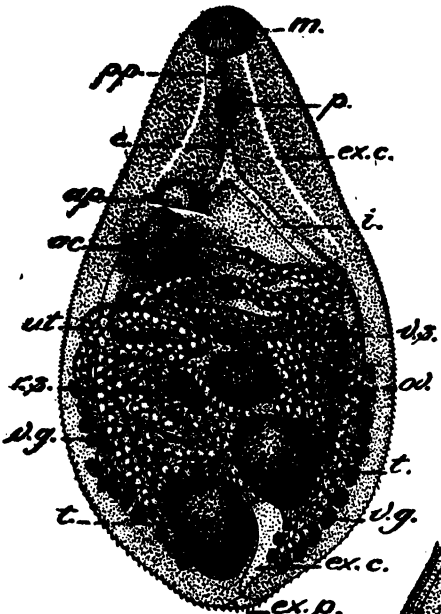
Yokogawa has found *Metagonimus yokogawai* occurring in the adult stage in man, dog, and cat, and has reared the worms to sexual maturity in dogs and mice fed with the cercariae. The usual host of the cercaria in Formosa is a trout (*Plecoglossus altivelis*), a fish commonly eaten raw in that country, but the cercaria has also been found encysted in *Carassius auratus* and *Leuciscus hacuensis* by Katsurada in Japan, as well as in *Plecoglossus*. According to Katsurada the cercaria is common in fishes in Korea, and he has observed the eggs of *M. yokogawai* in the feces of Koreans.

Ciurea (1915, pp. 445–458) has described *Loossia romanica* from the dog, *L. parva* from the cat, and *L. dobrogiensis* from the pelican in Roumania. The morphological differences in these three forms are chiefly those of size and color of the eggs.

Loossia romanica (figs. 8, 9) from the dog measures 0.6 to 1.56 mm. long, 0.4 to 0.54 mm. wide. Cuticular scales rectangular, 9 μ long, 5 μ wide, posterior free edge somewhat rounded, very minutely dentated; in anterior portion of body 3 μ apart; behind genital sinus become gradually smaller and less numerous toward the posterior end of the body. Oral sucker, 81 to 110 μ in diameter. Prepharynx 22 to 74 μ long according to state of contraction. Pharynx, 50 to 63 μ long by 30 to 44 μ broad. Esophagus, 86 to 143 μ long. Bifurcation of intestine about one-third the body length from the anterior end of body. Right intestinal cecum ends between the levels of the anterior and posterior border of the right testis; left cecum reaches nearly to the wall of the excretory vesicle. Ventral sucker, 96 to 165 μ long and 96 to 114 μ wide. Testes, 149 to 224 μ long by 121 to 187 μ wide. Ovary, 83 to 145 μ long by 88 to 165 μ wide. Eggs average 28 μ by 17 μ in diameter; reddish brown in color.

Loossia parva (fig. 10) from the cat measures 0.36 to 0.78 mm. long, 0.24 to 0.38 mm. wide. Cuticular scales relatively short and narrow, separated by wide intervals, especially on ventral surface of body. Oral sucker, 59 to 94 μ in diameter. Pharynx, 40 to 52 μ long, 22 to

35 µ wide. Intestinal ceca, of equal length, extend beyond posterior border of testes. Ventral sucker 66 to 132 µ long by 66 to 79 µ wide. Eggs yellowish-red in color.



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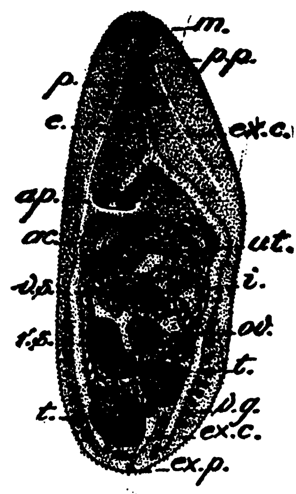

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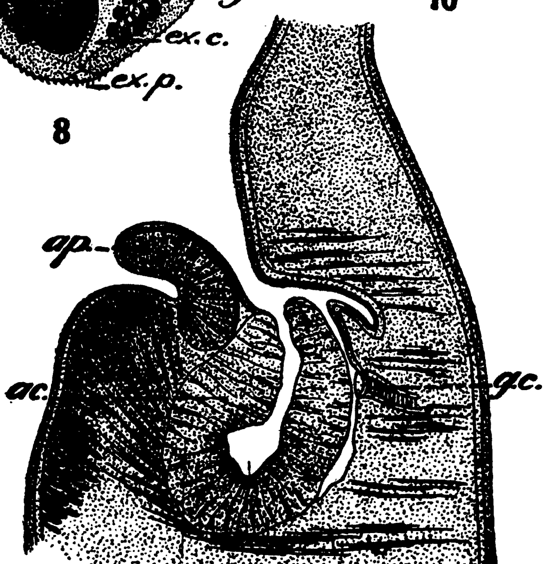

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FIGS. 8-10. 8.—LOOSSIA ROMANICA (=METAGONIMUS YOKOGAWAI). VENTRAL VIEW. × 87. AFTER CIUREA, 1915. 9.—LOOSSIA ROMANICA (=METAGONIMUS YOKOGAWAI). SAGITTAL SECTION THROUGH REGION OF VENTRAL SUCKER. × 235. AFTER CIUREA, 1915. 10.—LOOSSIA PARVA (=METAGONIMUS YOKOGAWAI). VENTRAL VIEW. × 87. AFTER CIUREA, 1915. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

Loossia dobrogiensis from the pelican measures 0.65 to 1.01 mm. long, 0.31 to 0.53 mm. wide. Cuticular scales broad, very close to-

gether. Oral sucker, 70 to 90 μ in diameter. Pharynx, 44 to 52 μ long by 31 to 41 μ wide. Intestinal ceca extend beyond posterior border of testes. Ventral sucker, 110 to 147 μ long by 77 to 107 μ wide. Eggs deep dark brown in color.

Ciurea fed dogs, cats, and pigs on various kinds of Roumanian fishes, maintaining appropriate controls, with the result that *Loossia romanica* developed in the dog, cat, and pig fed upon fish of the following species: *Esox lucius*, *Scardinius erythrophthalmus*, *Abramis brama*, *Carassius carassius*, *Aspius aspius*, *Idus idus*, and *Blicca björkna*. *Loossia parva* developed in a cat fed upon *Esox lucius*. He considers *Blicca björkna* and *Aspius aspius* to be the principal intermediate hosts of *L. romanica*.

Genus CRYPTOCOTYLE Lühe, 1899.

Generic diagnosis.—Heterophyidae: Prepharynx present but usually considerably shorter than esophagus. Esophagus short; bifurcation of intestine nearer to the oral sucker than to the ventral sucker. Intestinal ceca extend into the posterior end of the body, terminating behind the level of the testes. Ventral sucker, median, more or less rudimentary, in relation with the anterior portion of the genital sucker, and communicating with the exterior through the genital pore, which is located in the center of the genital sucker. Genital sucker well developed, situated in the median line about midway of the body. The genital sinus which opens to the exterior through the genital pore, and into which the vas deferens and vagina open, is posterior of the ventral sucker. A genital papilla projects into the genital sinus and is protrusible through the genital pore. Prostatic portion of vas deferens well developed, dorsal of and behind the genital sucker. Seminal vesicle well developed, situated behind the genital sucker, arranged in transverse loops, dorsal of the coils of the uterus. Testes near posterior end of body, irregularly oval or globular, and usually slightly lobed, side by side, or right testis obliquely behind the left. Seminal receptacle in front of and to the right of the left testis. Ovary irregularly oval, or usually lobed, commonly like a clover leaf, situated on the right side of the median line in front of the seminal receptacle. Vitellaria extend across body in front of genital pore, on the dorsal side of the branches of the intestine and often meet in the median line. Anterior limits of the vitellaria usually at a considerable distance posterior of the bifurcation of the intestine; posteriorly they extend behind the testes and usually cross the median line. Transverse vitelline ducts located in the neighborhood of the boundary between the ovarian and testicular zones. Uterus disposed in a few loops in the median line; none in front of the genital pore.

Type species.—*Cryptocotyle concava* (Creplin 1825).

KEY TO SPECIES.

1. Genital sucker over 100 μ in diameter .... 2.
   Genital sucker less than 100 μ in diameter .... *Cryptocotyle jejuna.*
2. Breadth of body usually more than half the length; testes side by side; eggs 34 to 38 μ long .... *Cryptocotyle concava.*
   Breadth of body usually less than half the length; testes usually obliquely one in front of other; eggs 40 to 50 μ long .... *Cryptocotyle lingua.*

CRYPTOCOTYLE CONCAVA (Creplin, 1825) Fischoeder, 1903.

Fig. 11.

1825. *Distoma concavum* CREPLIN, 1825*a*, pp. 45–47, 83, figs. 7–8 (in *Colymbus rufogularis*).
1892. *Distoma* (*Dicrocoelium*) *concavum* (Creplin, 1825) STOSSICH, 1892*c*, pp. 158–159, 188, 189.
1899. *Cotylogonimus* (*Cryptocotyle*) *concavum* (Creplin, 1825) LÜHE, 1899*k*, p. 539 (type of *Cryptocotyle*).
1899. *Tocotrema concavum* (Creplin, 1825) LOOSS, 1899*b*, p. 586.
1903. *Cryptocotyle concava* (Creplin, 1825) FISCHOEDER, 1903*h*, p. 548.

Specific diagnosis.—*Cryptocotyle:* Maximum length about 1 mm., width up to 0.85 mm. Oral sucker, 60 to 87 μ in diameter. Genital sucker, 150 to 300 μ in diameter. Pharynx, about 60 μ long by 50 μ broad. Esophagus about 95 μ long. Testes slightly lobed, transversely elongated, side by side, right and left; may attain 300 μ in major diameter. Ovary transversely elongated, slightly lobed. Eggs 34 to 38 μ long by 16 to 20 μ wide.

Hosts.—*Urinator stellatus*, *Colymbus cristatus*, *Colymbus nigricollis*, *Mergus merganser*, *Mergus serrata*, *Anas hornshuchii*, *Nyroca marila*, *Nyroca clangula*, *Nyroca hyemalis*, *Oidemia fusca*, *Alca torda*, *Colymbus rufogularis*, *Harelda glacialis*, *Larus glaucus*, *Phalacrocorax graculus*.

Location.—Small and large intestines.

Localities collected.—Europe.

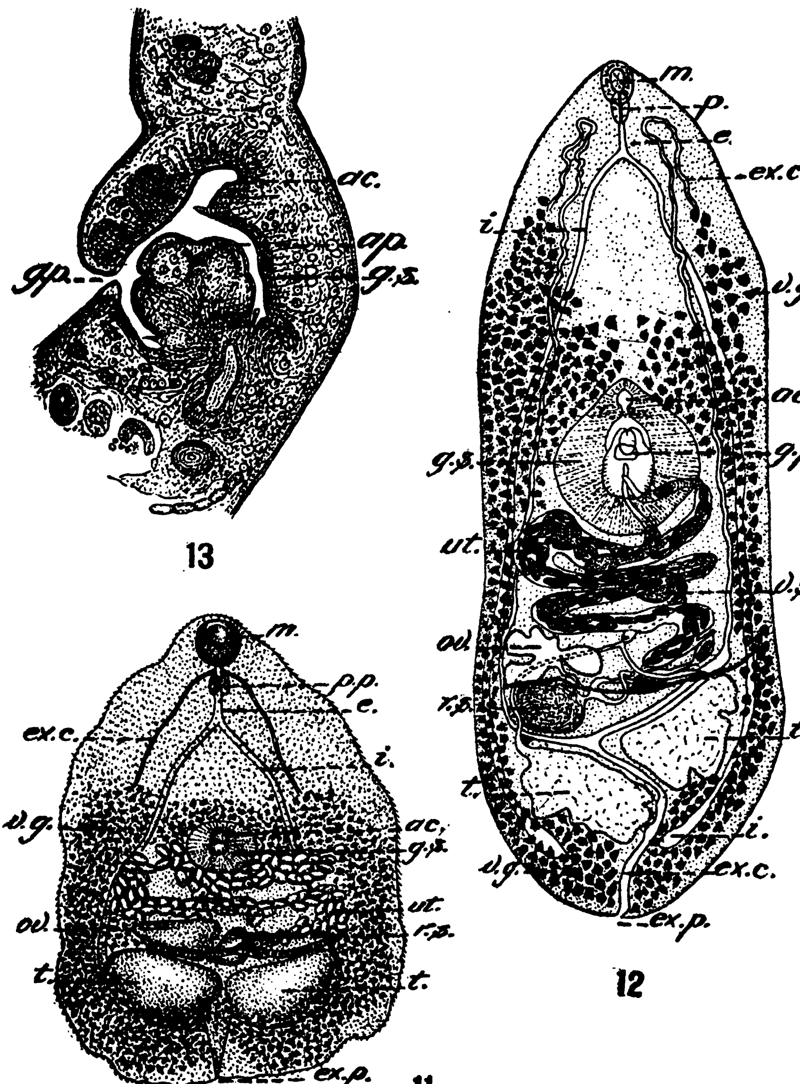
CRYPTOCOTYLE LINGUA (Creplin, 1825) Fischoeder, 1903.

Figs. 12–15.

1825. *Distomum lingua* CREPLIN, 1825*a*, pp. 47–48 (in *Larus marinus* v. *maximus;* apparently Europe).
1899. *Tocotrema lingua* (Creplin, 1825) LOOSS, 1899*b*, p. 586 (type of *Tocotrema*).
1903. *Cryptocotyle lingua* (Creplin, 1825) FISCHOEDER, 1903*h*, p. 548.
1905. *Dermocystis ctenolabri* STAFFORD, 1905*a*, p. 682 (in gills and skin of *Ctenolabrus adspersus*).
1918. *Hallum caninum* WIGDOR, 1918, pp. 254–257, figs. 1–4 (type of *Hallum;* in dog, Detroit, Mich.).

Specific diagnosis.—*Cryptocotyle:* Length, 0.55 mm. to 2 mm., or slightly more than 2 mm. in extended specimens: usually (Jäger-

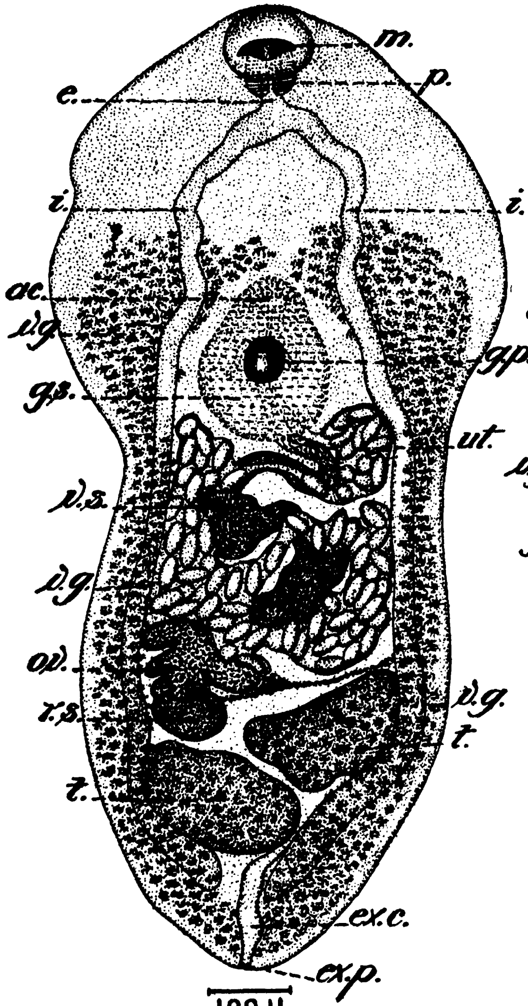
skiöld, 1899*a*) 1.5 to 1.7 mm. Width, 0.2 to 0.9 mm., usually (Jägerskiöld) about 0.4 mm. Cutaneous scales about 1 μ wide by 2 to 4 μ long. Oral sucker, 66 to 110 μ in diameter (about 80 μ accord-



FIGS. 11-13. 11.—CRYPTOCOTYLE CONCAVA. VENTRAL VIEW. × 71. AFTER NICOLL, 1909. 12.—CRYPTOCOTYLE LINGUA. VENTRAL VIEW. × 75. AFTER JÄGERSKIÖLD, 1899. 13.—CRYPTOCOTYLE LINGUA. SAGITTAL SECTION THROUGH REGION OF GENITAL PORE. × 214. AFTER JÄGERSKIÖLD, 1899. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

ing to Jägerskiöld, 75 to 85 μ according to Nicoll, 1907*f*, 70 to 90 μ according to Linton, 1915, 66 to 104 μ according to Wigdor, 1918). Prepharynx shorter in length than the pharynx. Pharynx, 30 to

48 μ wide, 40 to 80 μ long (30 by 60 μ according to Jägerskiöld, 45 by 60 μ according to Nicoll, 30 by 40 μ according to Linton, 66 to 80 μ long according to Wigdor). Esophagus short (280 to 320 μ long according to Jägerskiöld, but shown in his figure as about 50 μ long, 40



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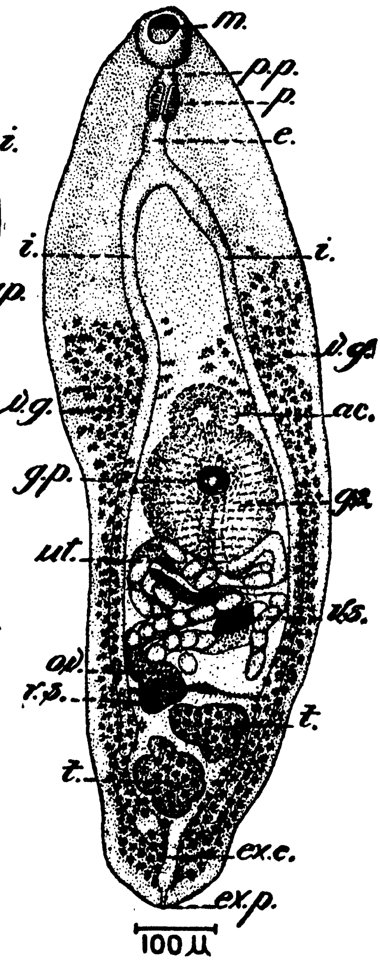

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FIGS. 14–15. 14.—CRYPTOCOTYLE LINGUA FROM DOG (HALLUM CANINUM, WIGDOR'S SPECIMEN). VENTRAL VIEW. × 110. ORIGINAL. 15.—CRYPTOCOTYLE LINGUA FROM SEAL. VENTRAL VIEW. × 110. ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

to 60 μ according to Nicoll and Wigdor). Bifurcation of intestine one-tenth to one-third the body length from the anterior end. Genital sucker near the middle of the body, transverse diameter 120 to

250 μ (180 to 250 μ according to Jägerskiöld, 136 to 184 μ, Wigdor). Ventral sucker, 55 to 85 μ in diameter, its cavity connecting with the genital sinus by a narrow tube. Right testis obliquely behind the left. Testes slightly lobed, irregularly globular or oval, 120 to 250 μ by 70 to 130 μ (about 250 by 130 μ according to Jägerskiöld). Ovary lobulated, may present the outline of a clover leaf; width, 140 to 180 μ; length, 70 to 120 μ (width 180 μ, length 80 μ, thickness 120 μ, according to Jägerskiöld). Vitellaria extend anteriorly beyond the level of the ventral sucker, usually a considerable distance, encroaching upon the median field in front of the ventral sucker, sometimes merging in the median line. Posteriorly they fill up most of the post-testicular region, and commonly cross the median line on the dorsal side of the excretory vesicle. Distance from the transverse vitelline ducts to the center of the ventral sucker greater than the distance from the latter to the anterior limits of the vitellaria, usually considerably greater, and may be four times as great. Eggs, 40 to 50 μ long by 18 to 25 μ wide (42 by 20 μ, Olsson, 1876*b*; 48 by 22 μ, Jägerskiöld; 47 to 49 μ by 22 to 25 μ, Nicoll; 40 by 20 μ to 47 by 23 μ, Linton; the minimum length given by Wigdor appears to be abnormal; according to him the length is 32 to 48 μ, width 18 to 22 μ).

Immature encysted stage.—Cysts 0.32 to 0.36 mm. in diameter, with transparent wall about 50 μ thick, surrounded by masses of black pigment cells: surface of cyst not covered by pigment. Worms extracted from cysts, 0.47 to 0.82 mm. long, 0.17 to 0.2 mm. broad. Oral sucker 50 to 60 μ wide. Pharynx 40 to 48 μ long by 21 to 35 μ wide. Surface of body covered with a dense coat of cuticular scales. Arrangement of internal organs, or of their rudiments, similar to that in the adult worms.

Hosts.—*Colymbus auritus; Gavia imber; Larus marinus; L. argentatus; L. fuscus; L. atricilla; Nycticorax nycticorax; Rissa tridactyla; Alca torda; Sterna dougalli; S. hirundo; Canis familiaris;* and *Phoca vitulina.* Immature stages encysted in cunner (*Tautogolabrus adspersus*); tautog (*Tautoga onitis*) and other fishes.

Location.—Intestine. (Immature stages encysted in skin and gills of fishes and free among adults in intestines of final hosts.)

Localities collected.—Europe; United States (Detroit, Michigan, Woods Hole, Massachusetts, and Washington, District of Columbia); Nova Scotia (Cape Breton).

Looss (1899*b*) took *lingua* as the type of the genus *Tocotrema* but its characters are so similar to those of the type of *Cryptocotyle* (*C. concava*) that the two can not be separated generically.

The most complete description of *C. lingua* is that given by Jägerskiöld (1899*a*). Nicoll (1907*b*) and Linton (1915) have added further data. Wigdor (1918) redescribed it as a new species. *Hallum*

caninum, from specimens taken from the small intestine of a dog at Detroit, Michigan, August 6, 1918, and made it the type of the genus *Hallum*. Through the courtesy of Parke, Davis, and Co., the writer has had the opportunity of examining three of Wigdor's specimens which have been entered in the Bureau of Animal Industry Helminthological Collections of the United States National Museum (No. 19028). These collections also contain some specimens of *C. lingua* collected from the intestine of *Phoca vitulina* by Dr. Albert Hassall, at the National Zoological Park, Washington City, December 21, 1905. (U.S.N.M. No. 4280.) The flukes from the dog (fig. 14) and the seal (fig. 15) measure 0.88 to 1.14 mm. in length, 0.34 to 0.56 mm. in width. The oral sucker is 70 to 110 μ in diameter. Pharynx, 40 to 48 μ in width by 50 to 60 μ in length. Ventral sucker, 60 to 85 μ in transverse diameter; genital sucker, 120 to 180 μ in transverse diameter. The distance from the anterior end of the body to the bifurcation of the intestine varies from 130 to 260 μ. The testes measure 120 to 200 μ by 70 to 120 μ; ovary, 100 to 180 μ by 70 to 120 μ; seminal receptacle, 60 to 120 μ in diameter. The eggs vary from 40 to 50 μ in length and from 18 to 24 μ in width. Wigdor evidently mistook the genital sucker for the ventral sucker, and interpreted the latter as the genital pore, also apparently confused the seminal vesicle and the uterus in his description of *Hallum caninum*.

Ryder (1884*a*) recorded the occurrence of encysted flukes in the skin, gills, and mouth of cunners caught at Woods Hole, Massachusetts, and Cape Breton, Nova Scotia. Linton (1900*a*, 1901*b*) recorded similar parasites from cunners and tautogs. Stafford (1905*a*) named these worms *Dermocystis ctenolabri*. Linton more recently (1915) has found these parasites in various other species of fish in the Woods Hole region and has secured very good evidence that they are immature stages of *C. lingua* which occurs among various fish-eating birds in the same region. They not only correspond morphologically with *C. lingua* but similar immature forms have been found among adults of *C. lingua* in the intestines of the final hosts.

CRYPTOCOTYLE JEJUNA (Nicoll, 1907) Ransom, 1920.

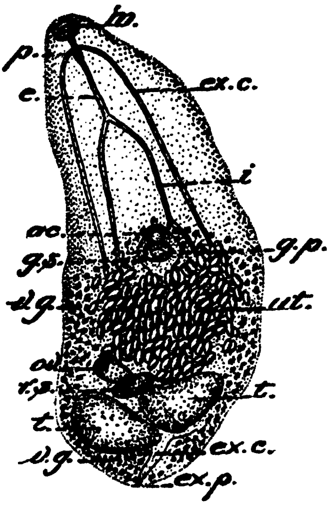
Figs. 16, 17.

1907. *Tocotrema jejunum* NICOLL, 1907*f*, pp. 248, 257–259; 1909, p. 483, pl. 10, figs. 20, 21.

1920. *Cryptocotyle jejuna* (Nicoll, 1907) RANSOM, 1920 (the present paper).

Specific diagnosis.—Cryptocotyle: Maximum length about 1.8 mm., maximum width varying from one-eighth to one-third the length. Oral sucker about 45 μ in diameter. Pharynx, 38 μ long by 18 μ wide; prepharynx somewhat shorter than pharynx. Average length of esophagus about 100 μ, nearly one-twelfth the body length. Geni-

tal sucker about 55 μ in transverse diameter. Testes irregularly oval, with indentations on their posterior border; right testis obliquely behind the left. Seminal vesicle voluminuos, extending back as far as



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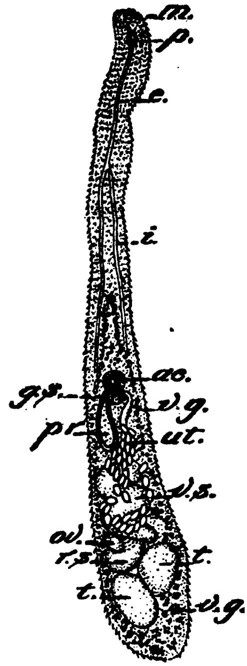

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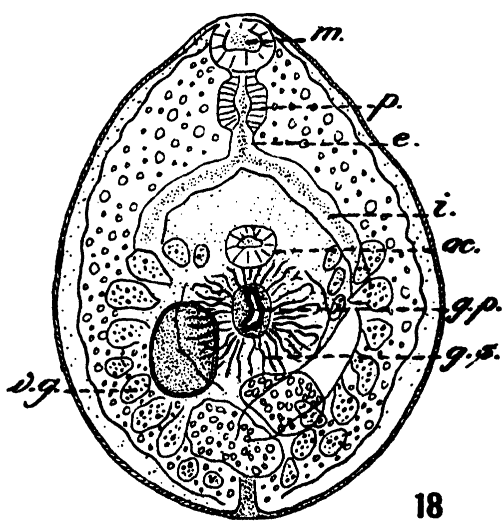

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FIGS. 16-19. 16.—CRYPTOCOTYLE JEJUNA. CONTRACTED SPECIMEN. VENTRAL VIEW. × 49. AFTER NICOLL, 1909. 17.—CRYPTOCOTYLE JEJUNA. ELONGATED SPECIMEN. VENTRAL VIEW. × 49. AFTER NICOLL, 1909. 18.—PARACOENOGONIMUS OVATUS. VENTRAL VIEW OF IMMATURE WORM FROM MOUSE. × 188. AFTER KATSURADA, 1914. 19.—PARACOENOGONIMUS OVATUS. ENCYSTED CERCARIA FROM FISH. × 27. AFTER KATSURADA, 1914. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

anterior testis, highly convoluted. Prostatic portion of vas deferens well developed, forming a pear-shaped body enclosed by a distinct membrane. Ovary small, roughly oval, lobed, a short distance in

front of testes on right of median line. Seminal receptacle near median line between ovary and testes. Vitellaria purely lateral in position except at the level of the genital sucker, where they bend in on each side and form a complete arch in front of the ventral sucker, the anterior limits of their distribution being in the immediate neighborhood of the level of the ventral sucker. Uterus arranged in three fairly regular transverse convolutions, laterally not extending much beyond the intestinal branches. Eggs numerous, light brown in color, 31 to 36 μ long by 16 to 19 μ wide.

Host.—*Totanus calidris.*

Location.—Intestine.

Locality collected.—Great Britain.

Genus PARACOENOGONIMUS Katsurada, 1914.

Generic diagnosis.—Heterophyidae: In characters thus far described resembles genus *Cryptocotyle* except that the egg is very large, over 100 μ long. Immature stage (encysted cercaria) in muscles of fresh-water fishes; adults presumably in intestine of fish-eating animals, young adults having been reared in mice fed with cercariae.

Type species.—*Paracoenogonimus ovatus* Katsurada, 1914.

PARACOENOGONIMUS OVATUS Katsurada, 1914.

Figs. 18, 19.

1914. *Paracoenogonimus ovatus* KATSURADA, 1914, pp. 313, 314, figs. 7, 8, 9, 12, 13 (immature stage in muscles of fishes, Plötzen, Brachsen, Barben, Plinten, Ukelei, etc.; Rivers Elbe and Alster, Germany; young adults in intestines of experimentally infected mice).

Specific diagnosis.—*Paracoenogonimus:* Young individual from intestine of mouse, four days after feeding immature stages in the muscles of "Alsterplötze," measured 0.522 mm. long, 0.378 mm. broad; oval in shape. Pharynx close behind the oral sucker; esophagus short. Bifurcation of intestine at the beginning of the second fourth of the body. Intestinal ceca extend into the posterior portion of the body. Ventral sucker about midway of the body, considerably smaller than the oral sucker; musculature very weakly developed. Genital pore median, a short distance behind the ventral sucker and surrounded by a genital sucker. Testes irregularly oval near posterior end of body; right testis obliquely behind the left. Vitellaria in lateral fields extending from the level of the ventral sucker into the post-testicular region. A single egg present, 116 μ long by 76 μ wide; brownish-yellow in color.

Immature stage (encysted cercaria).—Cysts rounded; 324 μ in diameter, wall of cyst 28.8 μ thick (Elbplötze); 317 μ by 306 μ in

diameter (Elbbrachsen); 360 μ in diameter, surrounded by a fibrous granular envelope 90 μ thick (Barbe). Cercaria from cyst, oval in shape, with a very prominent excretory vesicle. Cuticle armed with fine spines. Size of cercaria 0.486 mm. long, 0.36 mm. wide; oral sucker 57.6 μ in diameter; pharynx, 32.4 μ.

Hosts.—Immature stage (encysted cercaria) in the muscles of fishes from the Rivers Elbe and Alster: Plötzen (apparently type host), Brachsen, Barben, Plinten, Ukelei, etc. Young adult in intestine of experimentally infected mouse. Usual host of adult unknown.

Location.—Immature stage in muscles of fish. Adult presumably in intestine of fish-eating mammal or bird.

Localities collected.—Germany (Rivers Elbe and Alster).

So far as may be determined from Katsurada's (1914) description and figures *Paracoenogonimus ovatus* corresponds to *Cryptocotyle*, the only discrepancy being in the size of the egg, no previously known species of this genus or of the family Heterophyidae having eggs so large. The egg of Katsurada's species is more than twice as large as that of any other species of Heterophyidae. Further investigations are necessary before the form described by Katsurada can be properly placed.

Genus APOPHALLUS Lühe, 1909.

Generic diagnosis.—Heterophyidae: Prepharynx present but much shorter than the long esophagus. Bifurcation of intestine nearer to ventral sucker than to oral sucker. Intestinal ceca extend into the posterior end of the body well behind the testes. Ventral sucker median, about midway of the body, opening to the exterior through the genital pore. The genital sinus, which opens to the exterior through the genital pore, and in which the vas deferens and vagina terminate, is situated immediately in front of the ventral sucker. Well-developed seminal vesicle behind the ventral sucker. Testes globular or oval, in posterior third of body, the right testis usually obliquely behind the left, but the two may be side by side at the same level. Seminal receptacle in front of and to the right of the left (anterior) testis. Ovary globular, on the right side of the median line, in front of the seminal receptacle. Vitellaria extend forward to about the level of the ventral sucker, may be limited to the lateral fields in this region, but may extend inward to the median line in front of the ventral sucker; posteriorly the lobules of the vitellaria are numerous behind the testes and between them, and often are present on the dorsal and ventral sides of the testes. Transverse vitelline ducts located in the neighborhood of the boundary between the

ovarian and testicular zones. Uterus disposed in a few loops in the median field, none in front of the genital pore.

Type species.—*Apophallus muehlingi* (Jägerskiöld, 1899) Lühe, 1909.

KEY TO SPECIES.

Vitellaria extend a short distance anteriorly beyond the level of the ventral sucker and encroach upon the median field in this neighborhood; eggs 36 to 40 μ long; American .... *Apophallus brevis.*

Vitellaria do not extend anteriorly beyond the level of the ventral sucker and do not encroach upon the median field in this neighborhood; eggs 32.4 μ long; European .... *Apophallus muehlingi.*

APOPHALLUS MUEHLINGI (Jägerskiöld, 1899) Lühe, 1909.

Fig. 20.

1898. *Distomum lingua* CREPLIN of MUEHLING, •1898*a*, pp. 21–22; 1898*b*, pp. 29, 94–96, pl. 3, fig. 16 (in *Larus ridibundus;* misdetermination).

1899. *Distomum muehlingi* JÄGERSKIÖLD, 1899*a*, p. 7 (*lingua* of Muehling renamed as new species).

1899. *Tocotrema muehlingi* (Jägerskiöld, 1899) Looss, 1899*b*, p. 585.

1909. *Apophallus muehlingi* (Jägerskiöld, 1899) LÜHE, 1909, p. 62, fig. 53 (type of *Apophallus*).

Specific diagnosis.—*Apophallus:* Length, 1.2 to 1.6 mm.; width, 0.19 to 0.23 mm. Body much elongated, constricted near the middle in the region of the ventral sucker. Cutaneous scales, 2.9 μ long. Oral sucker, 54 μ in diameter. Prepharynx well developed (about as long as the diameter of the oral sucker according to Muehling's illustration). Pharynx, 37 μ in diameter. Testes globular, near the posterior end of the body; right testis obliquely behind the left. Ventral sucker of about the same size as the oral sucker. Genital sinus median, immediately in front of the ventral sucker. Seminal vesicle well developed, S-shaped, in median line behind the ventral sucker. Ovary globular or piriform, on right side of body between testes and ventral sucker, but nearer to the anterior testis than to the ventral sucker. Vitellaria do not extend anteriorly beyond the level of the ventral sucker and do not encroach upon the median field in this neighborhood. Posteriorly they are numerous in the median field behind the testes, between them, in front of them, and on the dorsal sides of the testes. Uterus relatively short, containing only a few eggs, which are brownish in color, 32.4 μ long by 18 μ wide.

Host.—*Larus ridibundus.*

Location.—Intestine.

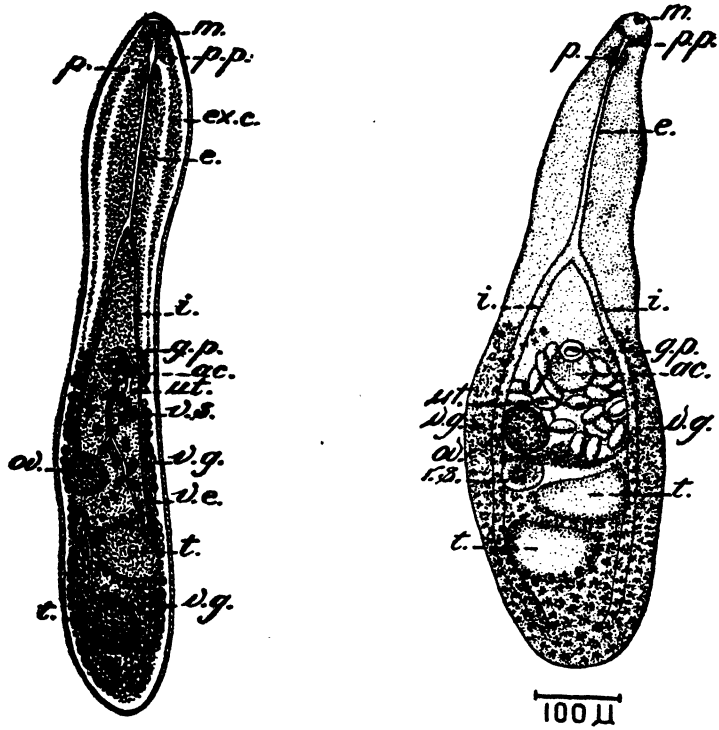
Locality collected.—East Prussia.

APOPHALLUS BREVIS, new species.

Fig. 21.

1920. *Apophallus brevis* RANSOM, 1920 (the present paper) (in *Larus delawarensis;* U. S.).

Specific diagnosis.—Apophallus: Length, 0.6 to 0.9 mm.; width, 0.18 to 0.26 mm. Cutaneous scales about 4 µ long by 2 µ wide. Oral sucker, 30 to 50 µ in diameter; prepharynx not over 20 µ in length; pharynx, 20 to 28 µ in diameter. Bifurcation of intestine about one-third the body length from the anterior end. Ventral sucker in



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FIGS. 20-21. 20.—APOPHALLUS MUEHLINGI. VENTRAL VIEW. × ABOUT 60. AFTER MUEHLING, 1898. 21.—APOPHALLUS BREVIS. VENTRAL VIEW. × 110. ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

about the middle of the body, 35 to 55 µ in diameter, opening to the exterior through the genital pore. Right testis usually obliquely behind the left, but the two may be located side by side right and left of the median line, 45 to 145 µ in transverse diameter, 45 to 120 µ in longitudinal diameter. Distance of posterior testis fom the posterior end of the body at least as great as the longitudinal diameter of the testis. Seminal receptacle, 40 to 80 µ in diameter. Ovary, globular or oval, 50 to 80 µ in transverse diameter, 60 to 90 µ in longitudinal diameter. Vitellaria extend anteriorly a short distance

beyond the level of the ventral sucker, encroaching on the median field in this neighborhood, and may unite in front of the ventral sucker. Distance from the transverse vitelline ducts to the center of the ventral sucker always somewhat greater than the distance from the latter to the anterior limits of the vitellaria, and may be twice as great. Posteriorly the vitellaria fill up most of the post-testicular zone, crossing the median line, also present between the testes, and may have numerous lobules on the dorsal and ventral sides of the testes. Eggs 36 to 40 μ long by 16 to 22 μ wide.

Host.—*Larus delawarensis.*

Location.—Intestine.

Locality collected.—Washington, District of Columbia.

Type specimens.—U.S.N.M. Helminthological Collections No. 2845, collected by Dr. A. Hassall, March, 1897.

Apophallus brevis is very similar to *A. muehlingi.* It is somewhat smaller, relatively broader posteriorly. The oral sucker is smaller, 30 to 50 μ as compared to 54 μ. The pharynx is also smaller, 20 to 28 μ as compared to 37 μ. The vitellaria extend farther forward, and encroach upon the median field in front of the ventral sucker, whereas in *A. muehlingi* as described by Muehling (1898*b*) they do not extend forward of the level of the ventral sucker nor into the median field anteriorly. The eggs are larger, 36 to 40 μ long in *A. brevis*, 32.4 μ long in *A. muehlingi.* Considering these differences it appears that *A. brevis* is specially distinct from *A. muehlingi*, though they are very similar to one another.

Genus COTYLOPHALLUS, new genus.

Generic diagnosis.—Heterophyidae: Prepharynx very short, practically absent. Bifurcation of intestine nearer to ventral sucker than to oral sucker. Intestinal ceca extend into the posterior part of the body, ending in the neighborhood of the level of the posterior border of the right testis. Ventral sucker median, one-third to one-half the body length from the anterior end, opening to the exterior through the genital pore. The genital sinus which opens to the exterior through the genital pore and in which the vas deferens and vagina terminate, is situated immediately in front of the ventral sucker. Prostatic portion of vas deferens well developed, situated posterior and dorsal of, and to the left of, the ventral sucker. Seminal vesicle well developed, forming a U-shaped loop, with its limbs one in front of the other, posterior and dorsal of the ventral sucker, dorsal of the coils of the uterus, base of the U to the right near the right branch of the intestine. Testes near posterior end of body, oval or globular; right testis obliquely behind the left. Seminal receptacle in front of and to the right of the left testis. Ovary globular or elongated,

sometimes bent upon itself with one lobe dorsal, the other ventral, and situated on the right side of the median line in front of and ventral of the seminal receptacle. Vitellaria extend across body in front of genital pore, on the dorsal side of the branches of the intestine, and often meet in the median line. Anterior limits of the vitellaria in the region of the bifurcation of the intestine; posteriorly they extend behind the testes, but do not cross the median line. Transverse vitelline ducts located in the neighborhood of the boundary between the ovarian and testicular zones. Uterus disposed in a few loops in the median field; none in front of the genital pore.

Type species.—*Cotylophallus venustus* Ransom, 1920.

KEY TO SPECIES.

Vitellaria with numerous lobules extending entirely across body in region between genital pore and bifurcation of intestine, elsewhere lobules disposed mostly in a single row right and left along the outer sides of the intestinal ceca -- *Cotylophallus similis.*

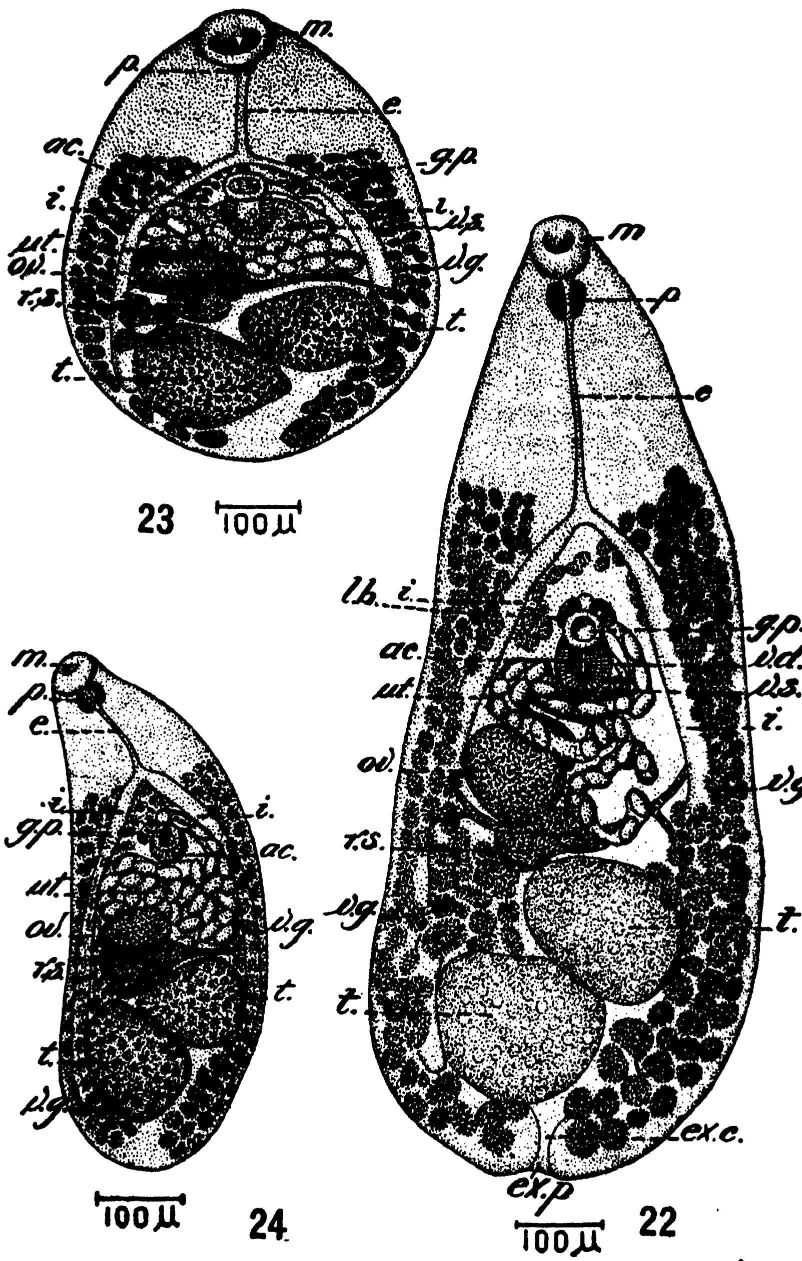
Lobules of vitellaria relatively not numerous in region in front of the genital pore, very scarce towards the median line, elsewhere disposed in several rows along the outer sides of the intestinal ceca and lapping over the latter dorsally and ventrally in the posterior half of the body -- *Cotylophallus venustus.*

COTYLOPHALLUS VENUSTUS, new species.

Figs. 22–25.

1920. *Cotylophallus venustus* Ransom, 1920 (the present paper), (type of *Cotylophallus*; in *Vulpes lagopus*; dog; cat; U. S.).

Specific diagnosis.—*Cotylophallus:* Length up to 1.3 mm.; maximum width, 0.23 to 0.65 mm., the length in expanded specimens being from twice to about three times the maximum width. Cutaneous scales about 5 μ long by 1.5 to 3.5 μ wide. Oral sucker, 40 to 90 μ in diameter. Pharynx, 30 to 70 μ in diameter. Bifurcation of intestine one-fifth to a little over one-third the body length from the anterior end; intestinal ceca extend into posterior fourth of body. Ventral sucker, 36 to 100 μ in diameter; 120 to 600 μ, or one-third to one-half the body length from the anterior end. Testes in posterior third of body, oval or globular; major diameter, 75 to 320 μ. Ovary, 70 to 180 μ in its major diameter, situated 200 to 800 μ (from about one-half to two-thirds the body length) from the anterior end of body. Vitellaria with comparatively few lobules in front of the level of the anterior border of the ventral sucker, very scarce in the median line; behind the level of the ventral sucker, being arranged in several rows along the outer sides of the intestinal ceca and testes, frequently overlapping the intestinal ceca; commonly a considerable



FIGS. 22-24. 22.—COTYLOPHALLUS VENUSTUS FROM FOX. VENTRAL VIEW. × 110. ORIGINAL 23.—COTYLOPHALLUS VENUSTUS FROM CAT. VENTRAL VIEW. × 110. ORIGINAL. 24.—COTYLOPHALLUS VENUSTUS FROM CAT. VENTRAL VIEW. × 110. ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

number of lobules in the space between the right testis and the ovary. Distance from the transverse vitelline ducts to the center of the

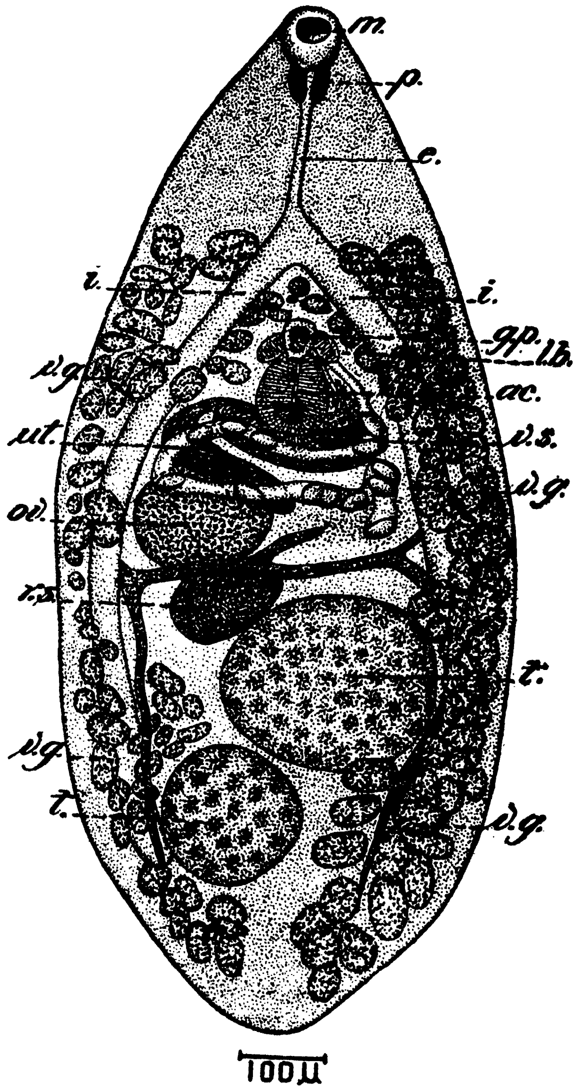


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FIG. 25.—COTYLOPHALLUS VENUSTUS FROM DOG. VENTRAL VIEW. × 110. ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

ventral sucker usually somewhat greater than from the latter to the anterior limits of the vitellaria. Eggs, yellowish-brown, 25 to 35 μ long by 15 to 20 μ wide.

Hosts.—Alaskan fox (*Vulpes lagopus*); dog; cat.

Location.—Intestine.

Locality collected.—Washington, District of Columbia.

Type specimens.—United States National Museum Helminthological Collections No. 19031, collected from an Alaskan fox, National Zoological Park, Washington City, by Dr. H. W. Graybill, May 2, 1906.

Besides the type specimens of *C. venustus*, the United States National Museum Collections contain specimens collected by Dr. E. C. Stevenson from foxes August 9, 1906 (No. 4487), and December 17, 1906 (No. 4657). There are also in the collections specimens collected by Stevenson from a dog May 25, 1907 (No. 14472), and specimens collected by Lieut. Col. E. R. Whitmore from the small intestine of a cat in 1918 (No. 19022), all in Washington, D. C.

The specimens from the cat (figs. 23, 24) are much smaller (0.3 to 0.7 mm. long, 0.23 to 0.45 mm. wide) than those from the foxes (fig. 22) and the dog (fig. 25), most of them quite immature and not yet containing eggs. Some of the largest contain a few eggs. The differences between the specimens from the cat and those from the fox, however, do not appear sufficient to justify the recognition of a distinct species.

COTYLOPHALLUS SIMILIS, new species.

Fig. 26.

1920. *Cotylophallus similis* Ransom, 1920 (the present paper), (in *Phoca vitulina;* U. S.).

Specific diagnosis.—*Cotylophallus:* Maximum length, 1.14 mm., usually between 0.5 and 0.9 mm.; maximum breadth, 0.22 to 0.39 mm. Cutaneous scales 1.5 to 3 μ wide, 4 to 7.5 μ long. Oral sucker, 65 to 85 μ in diameter. Pharynx, 30 to 44 μ in transverse diameter. Bifurcation of intestine, 135 to 265 μ (from about one-fourth to a little over one-third the body length) from the anterior end of the body; intestinal ceca extend into posterior fourth of body. Ventral sucker, 185 to 560 μ (about one-half, usually a little less than one-half the body length) from the anterior end of the body, 48 to 60 μ wide by 45 to 68 μ long. Testes in posterior third of body, oval or globular, 80 to 200 μ by 60 to 200 μ. Ovary 65 to 140 μ by 40 to 120 μ, situated 200 to 750 μ (about two-thirds the body length) from the anterior end of the body. Seminal receptacle, 60 to 130 μ by 35 to 90 μ. Vitellaria with numerous lobules extending across the body between the levels of the anterior border of the ventral sucker and the bifurcation of the intestine; behind the level of the ventral sucker, being arranged mostly in a single row on each side of the body along the outer sides of the intestinal ceca and testes; lobules scarce in the

space between the right testis and ovary. Distance from the transverse vitelline ducts to the center of the ventral sucker usually somewhat less than the distance from the latter to the anterior limits of the vitellaria. Eggs yellowish-brown, 30 to 35 μ long by 16 to 20 μ wide.

Host.—Harbor seal (*Phoca vitulina*).

Location.—Intestine.

Locality collected.—Washington, District of Columbia (National Zoological Park).

Type specimens.—United States National Museum Helminthological Collections No. 4279, collected by Dr. Albert Hassall, December 21, 1905.

Cotylophallus similis is very close to *C. venustus*, but is distinguishable from the latter by the relatively greater development of the vitellaria anteriorly and their restricted development posteriorly. In *C. venustus* there are not only a greater number of lobules of the vitellaria along the outer sides of the intestinal ceca, but the number in the spaces between the right testis and ovary and behind the left testis is much greater than in *C. similis.* Another almost constant difference is seen in the ratios of the distances between the transverse vitelline ducts, ventral sucker, and anterior limits of the vitellaria.

Genus CENTROCESTUS Looss, 1899.

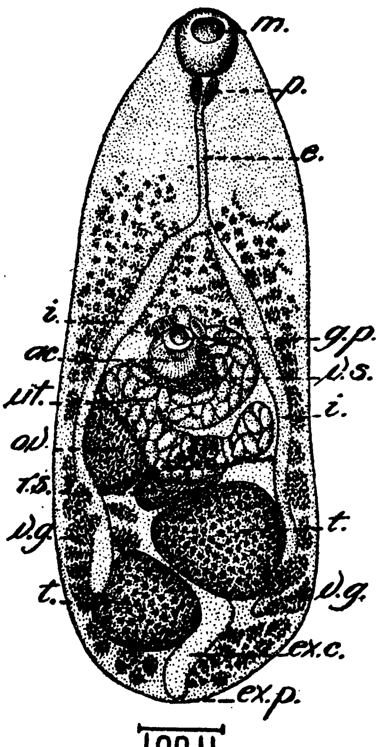
Generic diagnosis.—Heterophyidae: Mouth surrounded by a double crown of spines. Prepharynx long. Pharynx near the bifurcation of the intestine. Intestinal ceca extend into the posterior region of the body. Ventral sucker median. Genital sinus median, immediately in front of the ventral sucker. Prostatic portion of vas deferens well developed, situated along the right side of the ventral sucker. Well-developed seminal vesicle behind the ventral sucker, arranged in a U-shaped loop extending across the median field, the anterior limb of the loop the longer, base of the U to the left. Testes oval, elongated transversely, near posterior border of body, side by side, right and left of the median line. Seminal receptacle median, in front of testes. Ovary to the right of the seminal receptacle, in front of right testis, ovoid in form. Vitellaria arranged in numerous lobules in the lateral fields, extending from the region behind the testes nearly to the bifurcation of the intestine, encroaching upon the median field in front of the ventral sucker, and extending in this region inwards to or nearly to the median line. Transverse vitelline ducts in neighborhood of boundary between the ovarian and testicular zones. Uterus arranged in a few transverse loops, in the space between the testes and the ventral sucker. Terminal portion of uterus (vagina) passes forward to the genital sinus along the left side of the ventral sucker.

Type species.—*Centrocestus cuspidatus* (Looss, 1896) Looss, 1899.

CENTROCESTUS CUSPIDATUS (Looss, 1896) Looss, 1899.

Fig. 27.

1896. *Distomum cuspidatum* Looss, 1896b, pp. 97–101, 104, pl. 7, figs. 64–65 (in *Milvus parasiticus;* Egypt).
1899. *Anoiktostoma cuspidatum* (Looss, 1896) Stossich, 1899c, p. 15.
1899. *Centrocestus cuspidatus* (Looss, 1896) Looss, 1899b, pp. 582, 584 (type of *Centrocestus*).
1913. *Centrocestus cuspidatus caninus* Leiper, 1913, pp. 176–177, 1 fig. (in dog; Formosa).



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Figs. 26–27. 26.—Cotylophallus similis. Ventral view. × 110. Original. 27.—Centrocestus cuspidatus. Ventral view. × 128. After Looss, 1896. [For explanation of lettering see footnote, p. 532.]

Specific diagnosis.—Centrocestus: About 0.5 mm. long by 0.35 mm. wide when contracted, 0.75 to 0.8 mm. long when extended. Oral sucker, 50 µ in diameter. Mouth surrounded by a double crown of spines, 36 in number, 18 in each row, 10 µ long by 3 µ wide at the base. Pharynx, 30 µ long by 25 µ wide, separated from the oral sucker by a well-developed prepharynx. When the neck is extended the distance between the oral sucker and the pharynx may reach

150 μ. Bifurcation of intestine immediately behind the pharynx. Intestinal ceca extend into the posterior portion of the body, but their termination has not been definitely determined. Ventral sucker, 60 μ in diameter, located in contracted specimens at the beginning of the middle third of the body. Genital sinus transversely elongated, situated immediately in front of the ventral sucker. Testes 150 by 80 μ in diameter. Seminal vesicle very large. Prostatic portion of vas deferens well developed, cavity may be enlarged spherically to a diameter of 20 μ; terminal portion of vas deferens opening into the genital sinus may attain a diameter of 20 μ. Seminal receptacle may attain a diameter of 70 μ. Vitellaria are nearer the dorsal than the ventral surface, and extend from the neighborhood of the excretory pore in the posterior end of the body forward along the lateral borders and bend inward in front of the ventral sucker and behind the bifurcation of the intestine, nearly meeting in the median line. Uterus terminates in a vagina about 50 μ long, which empties into the genital sinus. Eggs yellowish-brown, 30 by 15 μ in diameter.

Hosts.—*Milvus aegyptius* (=*M. parasiticus*); dog.

Location.—Intestine.

Localities collected.—Egypt; Formosa.

Leiper (1913, pp. 176–177) describes and figures a fluke found in the feces of a dog in Formosa that corresponds to *C. cuspidatus*, but shows only 28 spines surrounding the mouth. As the single specimen collected was in a poor state of preservation, Leiper suggests that some of the spines originally present may have been lost. Leiper proposes that the fluke from the dog in Formosa be recognized as a variety, *Centrocestus cuspidatus caninus*, until material for further study is available, as it appears questionable to him that the same fluke should be found in the kite in Egypt and in the dog in Formosa.

Genus ASCOCOTYLE Looss, 1899.

Generic diagnosis.—Heterophyidae: Mouth surrounded by a crown of spines. Oral sucker with an elongated posterior cecum, extending backward on the dorsal side of the prepharynx. Prepharynx long. Pharynx near the bifurcation of the intestine. Bifurcation of intestine nearer to the ventral sucker than to the oral sucker. Ventral sucker median, posterior of the middle of the body, opening to the exterior, in some species, if not in all, through the genital pore. The genital sinus, which opens to the exterior through the genital pore, and in which the vas deferens and vagina terminate, is situated immediately in front of the ventral sucker. Well-developed seminal vesicle behind the ventral sucker. Testes globular or oval, side by side, near posterior end of body. Seminal receptacle in front of

testes. Ovary globular or oval, on right side of median line in front of seminal receptacle. Vitellaria not extending anterior of region of genital pore. Coils of uterus frequently overlap the intestinal ceca, but usually do not extend in front of genital pore. Eggs not over 25 μ long.

Type species.—*Ascocotyle coleostoma* (Looss, 1896) Looss, 1899.

KEY TO SPECIES.

1. Intestinal ceca short, do not extend back of posterior border of ventral sucker .... 2.
   Intestinal ceca extend a considerable distance behind the level of the ventral sucker .... 3.
2. Mouth surrounded by a double crown of spines; vitellaria extend forward into region of the ventral sucker .... *Ascocotyle coleostoma.*
   Mouth surrounded by a single crown of spines; vitellaria do not extend anteriorly beyond the level of the ovary .... *Ascocotyle minuta.*
3. Circumoral spines about 70 μ long; some of uterine coils in front of genital pore .... *Ascocotyle angrense.*
   Circumoral spines less than 25 μ long; uterus limited to region between testes and genital pore .... 4.
4. Oral cecum more than half the length of the prepharynx; circumoral spines 16 to 24 μ long .... *Ascocotyle longa.*
   Oral cecum less than half the length of the prepharynx; circumoral spines less than 15 μ long .... *Ascocotyle nana* or *Ascocotyle italica.*

ASCOCOTYLE COLEOSTOMA (Looss, 1896) Looss, 1899.

Fig. 31.

1896. *Distomum coleostomum* Looss, 1896*b*, pp. 101–106, 154, pl. 7, figs. 66–68 (in pelican; Egypt); 1899*b*, pp. 578, 581, 585 (type of *Ascocotyle*).

1899. *Ascocotyle coleostoma* (Looss, 1896) Looss, 1899*b*, pp. 582, 585, 699 (type of *Ascocotyle*).

Specific diagnosis.—*Ascocotyle:* Length, 0.7 to 0.8 mm.; maximum width, 0.25 mm. Cutaneous scales, 5 μ long. Mouth surrounded by a double crown of spines, 16 in each row, those of the anterior row 13 μ long, those of the posterior row a little shorter. Dorsal lip prolonged anteriorly in a short triangular process. Oral sucker, 90 μ in diameter; cavity funnel-like, continuous posteriorly with a hollow tapering process 230 μ long, usually bent in the form of an S. Pharynx, 60 μ long by 50 μ wide, immediately in front of the bifurcation of the intestine. Branches of intestine very short (150 μ), terminating in front of the level of the ventral sucker. Ventral sucker about midway of the body in contracted specimens. Testes irregularly round or oval; maximum diameter, 70 μ. Ovary irregularly spherical; maximum diameter, 60 μ. Seminal receptacle posterior of ovary, spherical, 80 μ in diameter. Vitellaria in lateral fields extending from the level of the anterior borders of the testes to the level of the genital pore. Transverse vitelline ducts at about

the level of the middle of the ovary. Coils of uterus extend from the anterior borders of the testes to the branches of the intestine, one or more coils being in front of the genital pore. Eggs, 15 μ long by 10 μ wide, with thick dark-colored shells.

Host.—Pelican (*Pelecanus onocrotalus*).

Location.—Ceca and large intestine.

Locality collected.—Alexandria, Egypt.

ASCOCOTYLE MINUTA Looss, 1899.

Fig. 28.

1899. *Ascocotyle minuta* Looss, 1899*b*, pp. 585, 689–699, 700, 701, pl. 26, fig. 23 (in dog, cat and *Ardea cinerea;* Egypt).

Specific diagnosis.—*Ascocotyle:* Length, about 0.5 mm.; maximum breadth, about 0.22 mm.; neck in extended condition may be reduced to a thickness of 17 μ. Oral sucker about 40 μ in diameter. Circumoral spines cylindrical, abruptly pointed posteriorly, 18 to 20 in number, arranged in a single crown; dorsal spines, 13 μ, ventral spines, 12 μ long. Oral cecum, 50 to 66 μ long. Ventral sucker, 45 to 56 μ in diameter, in the beginning of the broader, posterior portion of the body. Pharynx, 41 μ long by 24 μ wide, almost cylindrical, lies in the posterior region of the neck, a short distance in front of the bifurcation of the intestine. Intestinal ceca short; do not extend posterior of the region of the ventral sucker. Testes very small, oval, long axis transverse. Ovary in front of right testis and of similar size. Seminal receptacle in median line in front of testes. Vitellaria in lateral fields in posterior end of body, not reaching the level of the ventral sucker anteriorly. Eggs with relatively thick yellowish-brown shells, 23 to 24 μ long by 14 μ wide.

Hosts.—Dog; cat; *Ardea cinerea.*

Location.—Middle portion of small intestine (dog, cat), intestine (*Ardea*).

Localities collected.—Egypt (Looss); Brazil (by Faria, according to Travassos, 1916).

ASCOCOTYLE ITALICA Alessandrini, 1906.

1906. *Ascocotyle italica* Alessandrini, 1906, pp. 221–224 (in dog; Italy).

Specific diagnosis.—*Ascocotyle:* According to Alessandrini, very similar to *A. minuta* except in following characters: Dorsal lip apparently not projecting anteriorly as a triangular process. Intestinal ceca extend much behind the level of the ventral sucker, apparently reaching the excretory vesicle. Oral cecum much less than half the length of the prepharynx. Vitellaria not arranged in small scattered acini, but in two solid masses irregularly situated in the posterior part of the body. Testes much larger and much closer together. Eggs very numerous; uterus with numerous coils closely pressed together filling the space between the ventral sucker and testes.

Host.—Dog.
Location.—Intestine.
Locality collected.—Rome, Italy.

ASCOCOTYLE ANGRENSE Travassos, 1916.

1916. *Ascocotyle angrense* TRAVASSOS, 1916 (in *Butorides striata;* Brazil).

Specific diagnosis.—*Ascocotyle:* Length, 0.46 to 0.48 mm.; maximum width, 0.25 to 0.26 mm. Body piriform, concave ventrally. Cutaneous scales present in anterior portion. Oral sucker large. Circumoral spines cylindrical, with round points, about 72 μ long by 6 μ thick; ventral spines a little shorter than the dorsal spines. Oral cecum funicular in shape, 70 μ long. Ventral sucker 49 μ in diameter, situated about two-thirds the length of the body from the anterior end. Testes ellipsoidal, transversely elongated, about 106 by 71 μ. Ovary ellipsoidal, transversely elongated, anterior of testes, about 78 by 49 μ in diameter. Seminal vesicle large, elongated, behind ovary. Vitellaria small, composed of a few lobules situated in front and a little to the side of the testes. Uterus with numerous coils, some passing in front of ventral sucker. Eggs piriform, about 20 μ long by 10 μ wide.

Host.—*Butorides striata.*
Location.—Small intestine.
Locality collected.—Angra dos Reis, Est. do Rio, Brazil.

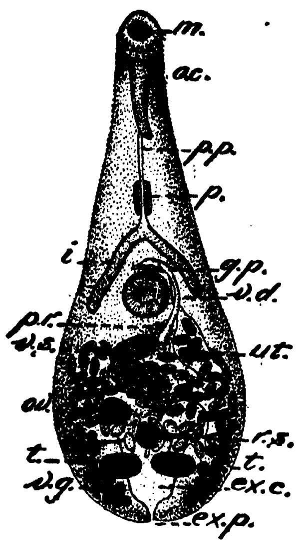
ASCOCOTYLE LONGA, new species.

Fig. 29.

1920. *Ascocotyle longa* RANSOM, 1920 (the present paper), (in *Vulpes lagopus;* U. S.).

Specific diagnosis.—*Ascocotyle:* Length, 0.85 to 1 mm.; maximum width, 0.27 to 0.35 mm. (near posterior end); body much attenuated anteriorly. Cutaneous scales about 7.5 μ long by 4 μ wide. Mouth surrounded by a single crown of heavy cylindrical spines with pointed posterior ends, 16 in number, those on the ventral side of the mouth varying from 16 to 18 μ in length, those on the dorsal side from 16 to 24 μ. Dorsal lip prolonged anteriorly in a short triangular process. Oral sucker, 80 to 85 μ long by 50 to 60 μ in transverse diameter, with a posterior hollow prolongation or oral cecum 140 to 160 μ long, about 20 μ in diameter anteriorly, tapering to a point posteriorly. The oral cecum is usually more or less bent and twisted especially near its posterior end. Pharynx globular or cylindrical, 45 to 60 μ in transverse diameter, located 190 to 350 μ from the anterior end of the body, about 50 μ in front of the bifurcation of the intestine. Intestinal ceca extend into posterior portion of body, terminating just in front of the testes. Ventral sucker, 50 to 55 μ wide by 70 to 75 μ long, situated 500 to 625 μ from the

anterior end of the body (a little over one-half the body length). Long axis of ventral sucker inclined with reference to the median line of the body, its posterior end being deflected to the right.



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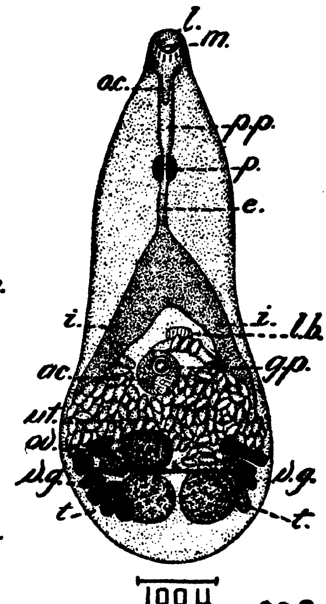

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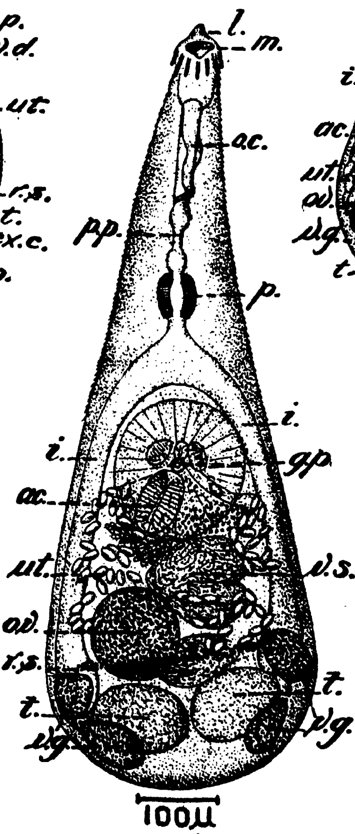

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FIGS. 28–30. 8.—ASCOCOTYLE MINUTA. VENTRAL VIEW (THROUGH ERROR THE ORAL CECUM IS SHOWN ON THE VENTRAL INSTEAD OF THE DORSAL SIDE OF THE PREPHARYNX). × 128. AFTER LOOSS, 1899. 29.—ASCOCOTYLE LONGA. VENTRAL VIEW. × 110. ORIGINAL. 30.—ASCOCOTYLE NANA. VENTRAL VIEW. × 110. ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 582.]

Genital pore in the center of a usually conspicuous vesicular swelling about 160 μ in diameter, the tissue involved in this swelling being of very loose texture, amid which are situated the ventral sucker,

genital sinus, and two muscular bulbs, lenticular in shape, on the right and left sides of the genital sinus. Prostatic portion of vas deferens well developed, situated behind and to the left of the ventral sucker. In the left side of the median field behind the prostatic portion of the vas deferens a large U-shaped seminal vesicle, the base of the U being slightly to the right of the median line. Testes oval, transversely elongated, in posterior sixth of body, measuring 75 to 135 μ by 50 to 95 μ. Seminal receptacle may attain a size of 100 by 75 μ, situated about in the median line just in front of the testes. Ovary globular or oval, 80 to 130 μ in its major diameter, in front of the right testis ventral of and to the right and in front of the seminal receptacle. Distance of center of ovary 670 to 800 μ (four-fifths the body length or a little more) from the anterior end of the body. Vitellaria in the posterior end of the body, consisting of 2 to 6 lobules in each lateral field, anterior limits in the posterior portion of the zone occupied by the ovary and seminal receptacle. A transverse vitelline duct extends inwards from the anterior portions of the vitellaria from each side, the two uniting near the median line, the right and left duct, respectively, passing on the ventral side of the ovary and seminal receptacle. Uterus forms four or five transverse loops in the median field, ventral of the seminal receptacle, ovary, and seminal vesicle, and often extending into the lateral fields on the ventral side of the intestinal ceca. Eggs, yellowish-brown, 16 to 18 μ long by 9 to 11 μ wide.

Host.—Alaskan fox (*Vulpes lagopus*).

Location.—Intestine.

Locality collected.—Washington, District of Columbia (National Zoological Park).

Type specimens.—United States National Museum Helminthological Collections No. 4448, collected by Dr. H. W. Graybill, May 2, 1906.

ASCOCOTYLE NANA, new species.

Fig. 30.

1920. *Ascocotyle nana* RANSOM, 1920 (the present paper), (in *Vulpes lagopus;* U. S.).

Specific diagnosis.—*Ascocotyle:* Length, 0.61 to 0.79 mm.; maximum width, 0.275 to 0.38 mm.; outline of body piriform. Cutaneous scales about 4 μ long by 2 μ wide. Circumoral spines 16 to 20 in number, 8 to 12 μ long, dorsally arranged in a double row, ventrally in a single row. Dorsal lip short, rounded, not triangular in outline. Oral sucker 35 to 45 μ wide, 40 to 50 μ long, with a small hollow oral cecum 30 to 60 μ long, 8 to 12 μ wide, terminating in a point posteriorly. Pharynx globular or cylindrical, 32 to 40 μ wide, 32

to 45 μ long, located 125 to 185 μ from the anterior end of the body, 40 to 100 μ in front of the bifurcation of the intestine. Intestinal ceca extend some distance posterior of the level of ventral sucker, posterior ends hidden by the coils of the uterus. Ventral sucker 365 to 465 μ from the anterior end of the body, 45 to 70 μ in diameter. In relation with the genital sinus on the left of the median line in front of the ventral sucker a lenticular muscular body, 40 to 45 μ wide and about 16 μ long. Testes globular or oval, 70 to 120 μ wide by 55 to 100 μ long. Seminal receptacle median, dorsal, just in front of testes. Ovary globular or oval, ventral, just in front of right testis, 55 to 80 μ wide, 50 to 100 μ long. Vitellaria ventral and lateral in position, in the zone occupied by the ovary and testes, not extending forward beyond the level of the anterior border of the ovary, and consisting of five or six relatively large lobules on each side of the body. Transverse vitelline ducts in the neighborhood of the boundary between the ovarian and testicular zones. Uterus a mass of coils filling up most of the body between the testes and ventral sucker, concealing the posterior ends of the intestinal ceca. Eggs 18 to 24 μ long, 10 to 16 μ wide.

Host.—Alaskan fox (*Vulpes lagopus*).

Location.—Intestine.

Locality collected.—Washington, District of Columbia (National Zoological Park).

Type specimens.—United States National Museum Helminthological Collections No. 19030, collected by H. W. Graybill, May 2, 1906.

A. nana is very similar in appearance and in many of its structural details to *Pygidiopsis genata* Looss, 1907, found in *Pelecanus onocrotalus*, at Cairo, Egypt. *P. genata*, however, is somewhat smaller (0.3 to 0.4, or if expanded, nearly 0.5 mm. in length), and no circumoral crown of spines or oral cecum is present. Apparently, also, *P. genata* is much more deeply concave on its ventral surface than *A. nana*. Otherwise the characters of *P. genata* including the presence of a lenticular organ on the left side of the genital sinus, distribution of the vitellaria, size of the eggs, etc., correspond almost exactly to those of *A. nana*. As Looss (1907, p. 490) remarks, *Pygidiopsis* is evidently very closely related to *Ascocotyle*. The great similarity of *P. genata* (the only and type species of *Pygidiopsis*) to *Ascocotyle nana* lends additional weight to Looss's remark as to the relationship of *Pygidiopsis*.

The type specimens of *A. nana* were taken from the intestine of the same fox that harbored the type specimens of *A. longa*.

It is possible that *A. nana* may be the same as the form very imperfectly described as *A. italica* by Alessandrini (1906), who collected it from a dog in Italy. *A. italica*, like *A. nana*, has a very small oral cecum, and apparently has a similar dorsal lip, similar

intestinal ceca, a similar distribution of the vitellaria and a similar uterus, but inasmuch as Alessandrini states that *A. italica* is similar to Looss's species, *A. minuta*, except for certain differences that he names, it must be presumed that *A. nana* is distinct from *A. italica* in view of the fact that it presents differences from *A. minuta* not mentioned by Alessandrini.

Genus PYGIDIOPSIS Looss, 1907.

Generic diagnosis.—Heterophyidae: Lateral borders greatly curved ventralwards. Prepharynx long, about equal in length to the esophagus. Bifurcation of the intestine nearer to the ventral sucker than to the oral sucker. Intestinal ceca extend into the posterior portion of body a considerable distance beyond the level of the ventral sucker, but not as far as the testes. Genital sinus median, immediately in front of the ventral sucker. A lenticular-shaped body about half as large as the ventral sucker in relation with the terminal portion of the vas deferens and the left half of the genital sinus and protrusible through the genital pore. Prostatic portion of vas deferens weakly developed. Seminal vesicle S-shaped. Testes oval, side by side, near posterior end of body. Ovary globular, in front of right testis near the ventral surface of the body. Seminal receptacle large, globular, median, anterior of testes, near the dorsal surface of the body. Vitellaria in lateral fields, ventral in location, near posterior end of body, consisting of a few relatively large lobules, limited to the region between the levels of the anterior border of the ovary and the posterior borders of the testes. Transverse vitelline ducts meet in median line ventral of seminal receptacle. Uterus occupies most of posterior portion of body behind the genital pore as far back as the testes. Vagina opens into the right half of the genital sinus. Eggs about 20 μ long.

Type species.—*Pygidiopsis genata* Looss, 1907.

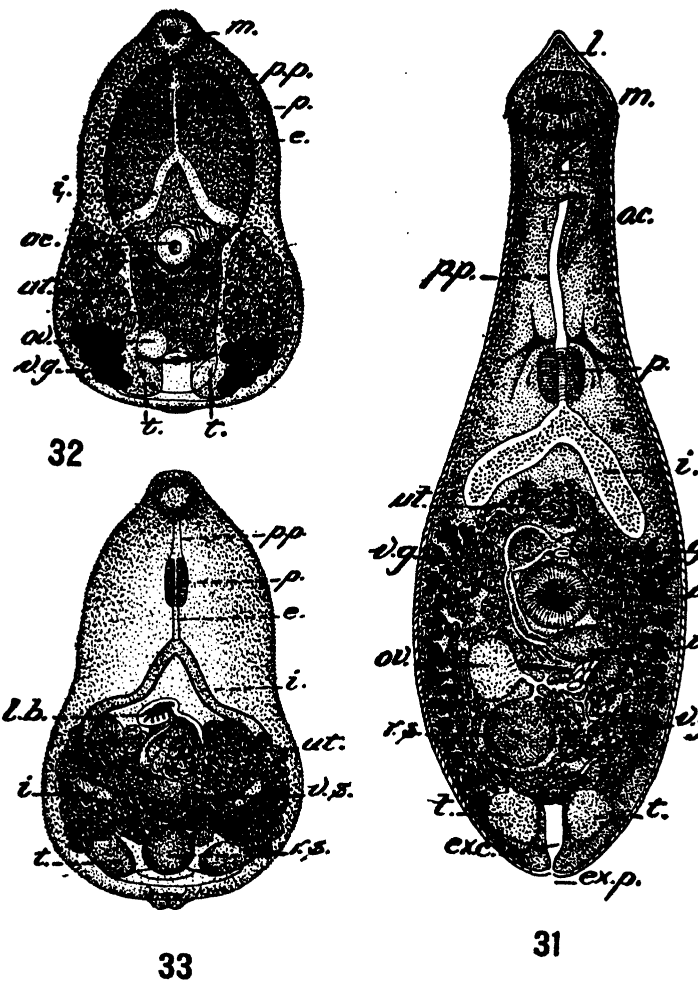
PYGIDIOPSIS GENATA Looss, 1907.

Figs. 32, 33.

1907. *Pygidiopsis genata* Looss, 1907, pp. 488–490, fig. 7 (type of *Pygidiopsis*; in *Pelecanus onocrotalus*; Egypt).

Specific diagnosis.—*Pygidiopsis:* Length may be nearly 0.5 mm., usually 0.3 to 0.4 mm.; maximum width, 0.2 to 0.22 mm. Lateral edges of body much curved ventralwards. Oral sucker about 40 μ in diameter. Prepharynx long. Pharynx, 36 μ long by 24 μ wide, about midway between the oral sucker and the bifurcation of the intestine. Intestinal ceca terminate about midway between the level of the ventral sucker and the level of the testes, turning toward the median line and dorsalwards near their termination. Ventral sucker 37 to 39 μ in diameter. Genital sinus immediately in front of the

ventral sucker, forming a rather deep transversely elongated cavity, into the right side of which the vagina opens. A lenticular-shaped body about half the size of the ventral sucker in relation with the terminal portion of the vas deferens, which empties into the left side of the genital sinus, this body being protrusible through the genital



FIGS. 31-33. 31.—ASCOCOTYLE COLEOSTOMA. VENTRAL VIEW (THROUGH ERROR THE ORAL CECUM IS SHOWN ON THE VENTRAL INSTEAD OF THE DORSAL SIDE OF THE PREPHARYNX). × 128. AFTER LOOSS, 1896. 32.—PYGIDIOPSIS GENATA. VENTRAL VIEW. × ABOUT 150. AFTER LOOSS, 1907. 33.—PYGIDIOPSIS GENATA. DORSAL VIEW. × ABOUT 150. AFTER LOOSS, 1907. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

pore. Prostatic portion of vas deferens weakly developed. Seminal vesicle S-shaped, the two posterior loops only ordinarily being visible as a U-shaped structure in the median line near the dorsal surface of the body behind the ventral sucker. Coils of uterus fill most of the posterior portion of the body behind the level of the ventral sucker

back to the anterior borders of the ovary and vitellaria, dorsally covering all the organs in this portion of the body, except the seminal receptacle, seminal vesicle, and ends of the intestinal ceca. Eggs light brown, thin-shelled, averaging 21 by 11 µ in diameter.

Host.—*Pelecanus onocrotalus.*

Location.—Intestine.

Locality collected.—Cairo, Egypt.

As Looss (1907, p. 490) remarks, this species is very closely allied to the genus *Ascocotyle*. It is especially like *Ascocotyle nana* elsewhere described in this paper, and although it is of somewhat smaller size it could scarcely be distinguished from the latter, were it not that oral spines and oral cecum are absent in *P. genata* and present in *Ascocotyle nana*. If *P. genata* should be shown to possess an oral cecum, even though it were very small and rudimentary, and if circumoral spines, which might be small and easily lost, should be discovered, this species would then undoubtedly fall into *Ascocotyle*.

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LARVAE OF NORTH AMERICAN BEETLES OF THE FAMILY CLERIDAE.

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INTRODUCTION.

The insects of this family are with few exceptions beneficial and of some economic importance in the preservation of forest trees because they in all stages feed on destructive wood and bark boring beetles.

The larval stages of the numerous genera and species of North American Cleridae have not been systematically described or figured, and but little has been published on their general habits and seasonal history in this country.

The present publication is a contribution from the Division of Forest Insect Investigations, Bureau of Entomology, United States Department of Agriculture, and has been worked out according to suggestions of Dr. A. D. Hopkins, forest entomologist in charge of forest insect investigations.

It consists of two independent parts. The first part, by A. G. Böving, deals with the morphology and taxonomy of the larvae of North American Cleridae and is mainly based on the valuable material, which has been accumulated in the collections in the office of the Forest Entomologist in the United States National Museum, Washington, District of Columbia. The second part, by A. B. Champlain, now Curator of Insects, Pennsylvania Bureau of Plant Industry, Harrisburg, Pennsylvania, deals with the general habits and seasonal history of the Cleridae from notes on file in the same office, critically considered and considerably added to by personal observations of the author.

PART 1.

A. BRIEF CHARACTERIZATION OF THE LARVAE OF THE FAMILY CLERIDAE.

Legs with fused tarsus and claw. Body straight with dorsal and ventral surface equally long or nearly so. Intersegmental membranes present. Tenth abdominal segment developed as a locomotory organ, extending from the ventral side of the ninth abdominal segment. No

filaments, no thornbearing dorsal plates, no spiracle bearing tubercles, no gills. Cerci, when present, inarticulate and immovable. Holopneustic. Spiracles annular or bifore. First thoracic spiracle plainly in pre-epipleurum of mesothorax. Head porrect and excerted or slightly invaginated. Labrum and clypeus present. Antennae three jointed. Mandibles posteriorly without mola; decreasing in width from basis to distal end, acuminate with single apex and usually with retinaculum; a deep groove along the cutting edge; no penicillum. Hypostoma with its maxillary margin adjacent only to cardo; postmaxillary margin adjacent to gula, and in some forms detached as a separate "paragular" structure. Ventral mouthparts, forming a compact unit, protracted or only slightly retracted; with restricted, principally dorso-ventral movement. Cardo maxillae as large or larger than stipes maxillae. Stipes maxillae, free, but movable only in dorso-ventral direction. Mala maxillae extending from the distal end of stipes; simple or transversally bisected. Palpus maxillae with three, free joints and a low, not joint-like palpiger, which is closely connected with stipes. Maxillary articulating area absent. Submentum well defined. Mentum small. Labium with two-jointed palpus. Ligula small, with simple, rounded anterior margin. Gula as long as frons, elongate, rectangular, limited by two parallel gular sutures, reaching from cardo's posterior end to foramen occipitale; no special pregular plate. Prothorax in the typical forms with two well separated presternal plates and an unpaired median sternal plate. Abdominal segments fleshy, plicate, without chitinous shield except on the ninth, which in most forms has a chitinous, dorsal cerci carrying plate. The abdominal segments often vividly colored, in many forms hairy, and often with ampullatory lobes.

B. GENERAL MORPHOLOGICAL DESCRIPTION OF THE LARVAE OF THE NORTH AMERICAN CLERIDAE.[1]

The body is digitiform without ampullae or flattened subclaviform, in most of the vividly colored, comparatively free living genera;

[1] Several of the terms used in the present paper may be found to differ from those applied by me in previous papers. In such cases the changes are based on renewed comparative morphological studies, jointly undertaken by Dr. F. C. Craighead and myself on a considerable amount of adult and larval stages of different insects. This revised terminology expresses our final contentions and consequently we regard the terminology expressed in our earlier publications as canceled and not to be drawn into further discussion. For explanation of most of the subsequent terms see: (1) John B. Smith: Explanation of Terms used in Entomology (Published by Brooklyn Entomological Society, Brooklyn, N. Y., 1906); (2) A. D. Hopkins: The Genus Dendroctonus (U. S. Dept. Agr., Bur. Ent., Tech. Ser. No. 17, Pt. 1, 1909); (3) Kemner, A.: Beiträge zur Kenntnis einiger Schwedischen Koleopterenlarven (Arch. f. Zool., vol. 7, pp. 2–4, 1912); also Kemner, A.: Våra Clerider (see the subsequent bibliography); (4) F. C. Craighead: Larvae of the Prioninae (U. S. Dept. Agriculture, Off. Sec. Rept., 1915); (5) Alvah Peterson: The Head Capsule and Mouthparts of Diptera (Illinois Biological Monographs, vol. 3, No. 2, 1916); (6) The Bibliography in G. C. Crampton's publication: The Thoracic Sclerites of Immature Pterygotan Insects, with Notes on the Relationships indicated. (Proc. Ent. Soc. Wash., vol. 20, No. 3, p. 60, 1918.)

digitiform with ampullae or vermiform, in the poorly colored or whitish genera which live permanently hidden in the galleries of their prey.

The Head is directed forward and protruded in free living genera; somewhat invaginate in the hidden forms. The dorsal surface of the head is flattened, the sides subparallel, and the ventral surface moderately convex in most of the free living genera, as *Necrobia*, *Enoclerus*, and *Cymatodera;* the sides of the head are curved, posteriorly diverging, and the head capsule as a whole subconical in the genera *Chariessa*, *Phyllobaenus*, and allies; the dorsal surface is short and flat, the sides posteriorly diverging, and the ventral surface large and very convex in *Priocera;* dorsal surface convex, sides parallel, and ventral surface flat in *Thaneroclerus.*

The Frons (*f*) is in most genera simple triangular, limited by straight or slightly curved frontal sutures, which posteriorly form an acute angle and reach the occipital foramen; in *Hydnocera* a quadrangular frons occurs, posteriorly limited by a transverse line and laterally by straight frontal sutures (*fs*), which reach the occipital foramen separately; in *Priocera* the frons is anteriorly broadly subquadrangular, posteriorly contracted into a narrow, stalk-like projection, which reaches the occipital foramen; finally, in *Thaneroclerus* the frontal sutures do not reach the occipital foramen, but meet in front of it. The dorsal surface of the frons is usually without conspicuous sculpture; in *Priocera castanea* and *Monophylla terminata*, however, it bears a prominent median unpaired elevation. Epistoma (*ep*), the anterior marginal thickening of frons between the upper articulations of the mandibles,[1] is always chitinized, even in forms in which the head is otherwise but slightly chitinized. Anguli frontales (*af*) are present but not large. Medianly and internally a longitudinal endocarina is present and well chitinized in all forms, and often posteriorly widened like an arrowhead.

The Epicranium (*ecr*) is dorsally completely separated by the frons into two epicranial halves, except in *Thaneroclerus*, where the halves meet posteriorly in the middle line and form an epicranial suture; ventrally the epicranial halves are continued behind the attachments of the tentorial arms and are in all Clerids separated by an elongate rectangular gula. The shape of the anterior or maxillary margin (*mh*) of hypostoma[2] is an important aid in the separation of the groups. It is straight in several genera, as *Enoclerus* and *Thanero-*

[1] According to Schiödte's terminology "epistoma" means the entire frons.

[2] Hypostoma is a structure, often of triangular form, along the ventral border of the epicranium. Its anterior or maxillary margin is here understood as the inner margin of hypostoma between the ventral mandibular articulation and the point of intersection between hypostoma and anterior margin of gula; in the Clerid larva this point of intersection is indicated by the posterior tip of cardo.

clerus, slightly concave in most of the genera, and conspicuously incurved and oblique in *Trichodes* and *Priocera*. The dorsal and ventral faces of epicranium are smooth or slightly sculptured in all forms, with one exception, *Enoclerus sphegeus*, where a large tubercle is developed dorsally on each epicranial half near the posterior end of the frontal sutures.

The Ocelli (*oc*) are located on epicranium behind the ventrolateral part of the antennal ring. They are usually of moderate size but projecting so much that they can be traced on the cast skins. Their number vary according to genera or groups of genera, with five in the plurality of the forms, four in *Tarsostenus*, three in *Cymatodera*, two in *Necrobia*, one in *Monophylla* and *Priocera*, and no distinctly marked ocellus in *Orthopleura*.

The Clypeus (*c*) is well developed, trapezoidal, without setae; in several forms rather indistinctly, in others distinctly separated from frons.

The Labrum (*l*) is well developed, movable, subrectangular, with rounded corners; its anterior margin may be slightly convex as in *Monophylla*, straight as in *Cymatodera* or slightly sinuate as in *Enoclerus;* a series of setae are placed along the anterior margin and a few on the disk within the margin.

The Antenna (*a*), projecting from an antennal ring, exceeds the anterior margin of the labrum, in all forms except *Hydnocera*, where it reaches that margin; the articulating basal membrane (*bm*) is large, in some forms joint-like, extended. The basal joint (*I*) is large in most of the genera, from two to four times as long as the second joint (*II*); only in *Orthopleura* and *Priocera* short, in the former genus as long as the second joint, in the latter half as long. The second joint carries a small, supplementary joint-like appendix (*fil*), except in *Hydnocera*, where it is well developed; the apical joint (*III*) is conical and small, except in *Hydnocera*, where it is twice as long as the second joint.

The Mandible (*md*) is fitted both to grasp and chew a prey and to gnaw galleries in wood; it is well chitinized and well developed, half or nearly half as long as frons. It is subtriangular; the exterior, lateral face is narrow and without elevated margin; the apex (*apx*) is simple, more or less pointed, except in the deviating genus *Priocera*, where it is blunt; the pars scissoria has a longitudinal groove (*g*) on the ventral side; the retinaculum (*r*) is present on the middle or close to the middle of the cutting edge, and a convex, serrate, or tooth-like elevation is developed in many forms between retinaculum and the tip of the mandible. *Priocera* is the only genus where retinaculum is minute and granuliform and the whole cutting edge nearly entire. No molar part, no prostheca, no mandibular brush is present in any Clerid. There are usually two setae on the lateral

mandibular face or close to it; in the hairy genus *Trichodes* there are about seven setae.

The Ventral Mouthparts are either protracted or, as in *Trichodes* and *Priocera*, slightly retracted. The Cardines and the Submentum form together a large, transversal, subeliptical posterior unit that articulates with the stipites and mentum. The Cardo (*ca*) is large, triangular, or trapezoidal with the longitudinal sides parallel. In the genus *Enoclerus* most of cardo is heavily chitinized and only a small anterior part is membranous, but in the majority of the genera only a narrow band of chitin is found along the posterior margin. The Stipes maxillae (*st*) has about the same size as cardo and is chitinized in much the same way. The Palpus maxillae (*pmx*) has three free joints carried by a broad, low, subannular palpiger maxillae (*pgm*); the latter is closely connected with the stipes, but usually distinguishable as an independent structure by a flat chitinization (*pgc*). In most of the genera the three free joints are of the same length; in *Monophylla* and *Phyllobaenus* the apical joint (*III*) is twice as long as the second (*II*), and in *Hydnocera* the apical joint is very small, about one-fifth the size of the second joint. The Mala (*la*) is flat, setigerous, extending from the end of stipes; in *Enoclerus* and other genera it is transversely bisected into an anterior and a posterior section, the anterior being well chitinized, the posterior membranous. The Area articularia maxillaris (or maxillary sclerite or maxillary articulating lobe) is totally absent. The Submentum (*sm*) is subquadrate or rectangular, laterally limited by cardo, posteriorly by the front margin of gula, and anteriorly separated from mentum by a suture; in some genera as *Enoclerus* the posterior half is chitinized and the anterior membranous, but in most genera the submentum is totally membranous; it is often setiferous. The Mentum (*m*) is free or nearly so, subconical, of somewhat different size in the different genera; usually setiferous; in the genus *Enoclerus* it has a basal chitinization. The Labium (*li*) consists of stipes labii, palpus labii and ligula. Stipes labii (*sli*) is somewhat smaller than mentum, often with palpiger labii (*plg*) separately chitinized. The Palpus labii (*pli*) is two jointed; both joints are well developed and of about equal size, except in *Hydnocera*, where the apical joint is four times as long as the basal joint. The Ligula (*lig*)[1] is present but small. The Gula (*gu*) is much longer than wide, on each side limited by a Gular Suture (*gus*). The gula is as long as frons, elongate, rectangular, often chitinized as a gular

[1] The term ligula is used here according to the terminology of Schiödte and other authors. Instead of ligula some authors, however, (as Alvah Peterson in his previously, p. 576 quoted monograph) use the term glossa.

plate, the surface of which is level in all genera except *Thaneroclerus*, where a large unpaired tubercle is developed medianly. In some forms the inner postmaxillary margin of hypostoma is on each side separated as a Paragular plate (*pgu*), adjacent to the lateral margin of gula.

The Epipharynx (*epx*, fig. 116) forms the dorsal wall of the buccal cavity; it carries a pair of large, rounded epipharyngeal plates (*epxp*), which usually are fused in the middle line; they are slightly chitinized, smooth, and without setae; but a small group of short, very stout, tooth-like setae occur in front of each. On the dorsal surface of labium Lingua (*lin*, fig. 31) forms the anterior part of the ventral wall of the buccal cavity; it is equal in size to the exposed ventral surface of labium, is thick, fleshy, and covered with sensory hairs and papillae. The Hypopharynx (*hy*) forms the posterior part of the ventral surface of the buccal cavity; it is located above the mentum and as large as this structure. Anteriorly on each side of it is found a free, bifid and tooth-like end of a rod-like vertical projection from the ventral chitinous surface of stipes; and, corresponding to the epipharyngeal plate, is developed, at the entrance to pharynx, a pair of rather large, round, smooth, partly coalescent hypopharyngeal plates. Hypo- and Epipharyngeal Rods (*hr* and *er*) are present along the longitudinal margins respectively of hypo- and epipharynx; they fuse on each side at the entrance to pharynx into a simple rod; this follows the pharynx for a short distance, but soon separates as a free structure which continues through the interior of the head and attaches posteriorly to the innerside of frons.

The Tentorium (*tea*) is poorly developed as a pair of slightly chitinized, blade-shaped rods, originating from the gular margin of hypostoma and ending anteriorly as a thin membrane, attached to the innerside of frons near the antennae. A tentorial cross bridge and a pair of posterior prolongations lack, or are possibly represented by a peculiar trifurcate formation (*tb*) attached interiorly to the posterior end of the gular plate.

The Prothorax (*Pr*).—Notches (=*Nodi*).—No distinct notches occur in the cervical membrane except a pleural notch at the upper corner of the hypopleural chitizination (*ph*), but posteriorly, in the intersegmental membrane between pro- and meso-thorax, are developed a dorsal notch (*dn*) rather close to the dorsal middle line of the body, a lateral notch (*ln*), a pleural notch (*pn*) just behind the lateral notch, a ventral notch (*vn*) interiorly developed into a spine, and finally a sternal notch (*sn*) in front of the ventral notch and at the end of a median, sternal, chitinous plate.

Sutures.—The prothoracic dorso-lateral suture is indistinct; but the prothoracic ventro-lateral suture (*vl*) between the pleural notch

in front and the lateral notch behind is horizontal and straight, it separates deeply the epipleural and hypopleural areas.

Areas.—The prothoracic tergal region (*Prtg*) is subsellate with transverse straight front margin, with rounded, posteriorly oblique side margin which ends at the dorsal notch and with transverse, short hind margin above the dorsal notch. The median area of epipleurum is incorporated in tergum or possibly replaced by a lowering of tergum. With exception of a narrow lateral margin the whole tergal region is covered by the tergal shield. In most genera, this shield is somewhat broader than the head and only in a few genera, as *Thaneroclerus*, of the same size. The preepipleurum (*pe*) is small, and no preepipleural arm is developed in prothorax. The Postepipleurum (*poe*) is triangular and well developed. The Hypopleurum has usually Pre- and Posthypopleural chitinizations (*ph* and *poh*).[1] These are separated by a short, vertical Hypopleural Suture (*hs*) above a little, ventrally extending hypopleural arm, which carries an articulating fossa for the coxal condyle. The Presternal Area (*pst*) is distinctly developed in the cervical membrane and conspicuously marked by a pair of subtriangular or rounded presternal plates, one on each side of the middle line. The Preeusternum (*pres*), a sternal area in front of the prehypopleural chitinization, and the Eusternum (*es*), behind this structure, are fused and often medianly covered with a common, unpaired Sternal Plate (*stp*). The form of this plate varies according to genera or groups of genera and is of distinct systematic value; narrow and lanceolate in *Enoclerus* and genera related to *Enoclerus*, broad and pyriform in *Chariessa* and genera of this type, and subquadrate in a genus as *Monophylla*. The lateral arms of *Eusternum* are not chitinized. The Sternellum[2] is not present as a distinct area; its median part or Mediosternellum is possibly fused with eusternum and each lateral part or Laterosternellum is possibly fused with the large lobe around coxa. The Posternellum

[1] The terms Pre and Posthypopleural chitinizations are used here instead of the more generally used terms Episternum and Epimeron (compare Crampton, Proc. Ent. Soc. Wash., vol. 20, p. 8, 1918), because a comparison between the muscles from pre- and posthypopleurum in Coleopterous larvae with those from episternum and epimeron in the Coleopterous adults shows that these larval and adult areas are not quite homologous. We find, for instance, that all the muscles in the adults, from episternum to the leg and the region near the leg, only correspond to part of the muscles which in the larvae extend between prehypopleurum and the leg and the region near the leg, while the rest of the prehypopleural muscles in the larvae are homologous with muscles which in the adults attach to the large wing-supporting Prebasalar Plate above episternum.

[2] The Sternellum consists of a median part or Mediosternellum and a lateral part or Laterosternellum on each side. Where the mediosternellum and the laterosternellum are well developed as in the larvae of Carabids and Silphids, the mediosternellum forms a triangular area which anteriorly is separated from the eusternum by a transverse suture between the furcal pits, and laterally defined by oblique sutures between the furcal pits and the sternal notch, while each laterosternellum is anteriorly adjacent to the lobe carrying and surrounding coxa, and laterally and internally adjacent to mediosternellum and posteriorly limited by the suture between the lateral notch and sternal notch.

(*post*)[1] is subtriangular; in forms as *Enoclerus*, large with a small chitinous median plate and a deep ventral notch which inside develops into a strong spina; in other forms as *Monophylla*, rather insignificant.

The Meso- and Metathorax (*Ms* and *Mt*) are subequal.

Notches (*Nodi*).—The notches belonging to meso- and metathorax are present in the same numbers and placed in the same way as between pro- and meso-thorax. Between metathorax and first abdominal segment the dorsal notch is pushed somewhat downwards, while the lateral notch occurs on the same horizontal level as the preceding lateral notch; the ventral notch is only indicated faintly, is without spina, and confluent with the sternal notch just in front of it; the pleural and sternal notches as in prothorax.

Sutures.—The dorso-lateral suture, separating tergum and epipleurum is indistinct; the ventro-lateral suture below epipleurum and between two succeeding lateral notches is horizontal and straight; it is shallow or even indistinct between the lateral notch in front of the segment and the pleural notch immediately behind, but distinct between this pleural notch and the lateral notch behind; it is especially deep above the prehypopleural chitinization; the scuto-scutellar suture, which separates the scutal and scutellar areas, is short and transversal.

Areas.—Tergum is subsellate with a short, straight, transversal front margin above the dorsal notch in front of a segment, with a deeply curvate, posteriorly oblique side margin between two subsequent dorsal notches and with a short hind margin above the dorsal notch behind. The tergal areas are slightly indicated. Prescutum (*psc*) is bandlike and mainly developed as a dorsal part of an intersegmental membrane.[2] Scutum (*sc*) and Scutellum (*scl*) are only distinctly separated in front and behind the scuto-scutellar suture. Just behind and below this suture a chitinous plate is developed in many genera; usually larger on meso- than on metathorax. The Alar area (*aa*) is large and reaches the ventro-lateral suture in front of the pleural notch after having replaced or possibly incorporated the

[1] The term Poststernellum is here applied to that area behind sternellum which is limited anteriorly by the transverse, straight suture through a sternal notch between two corresponding lateral notches, and posteriorly by the transverse, curved or medianly angular suture through the ventral notch right behind the sternal notch and between the same pair of lateral notches.

[2] The intersegmental membrane is not a constant, well-defined morphological formation, but is a structure developed for purely mechanical purposes and of changing morphological nature in different coleopterous families as well as in the different insect orders; sometimes the membrane is to be derived from the anterior, sometimes from the posterior parts of the two segments which it connects. The attachments of the longitudinal segmental muscles indicate the morphological nature of the membrane; if they attach in front of the membrane this is composed of presegmental elements, if they attach behind the membrane this is of postsegmental nature. In the Clerids the dorsal part of the intersegmental membrane belongs to prescutum, the lateral part contains both pre- and post-epipleural elements, and the ventral part below the lateral notch belongs to poststernellum.

median area of epipleurum. Postscutellum (*pos*) is of moderate size and forms the membranous hind margin of the tergum. The Preepipleurum (*pe*) is large and carries on mesothorax the well developed first thoracic spiracle, on metathorax the rudimentary second thoracic spiracle; ventrally the preepipleurum is limited by that anterior part of the ventro-lateral suture which is found between the lateral notch and the pleural notch, dorsally it is prolonged into a preepipleural arm in front of tergum, ending at the dorsal notch. The Postepipleurum (*poe*) is very large, triangular, adjacent to the preepipleurum of the next segment along a vertical line from the dorsal to the lateral notch. The Hypopleurum is identical with the hypopleurum of the prothorax. The Presternum (*pst*) is present on each side of the body as a triangular, large, swollen area, dorsally indistinctly limited by the anterior part of the ventro-lateral suture and more or less confluent with the preepipleurum and the ventral corner of the alar area, ventrally reaching the ventral notch. The Preeusternum and the Eusternum (*pres* and *es*) are fused and in some forms, as *Enoclerus sphegeus*, provided with a small, unpaired sternal plate; the eusternal lateral arm is distinguishable in most genera. The Sternellum is not present, its median part or Mediosternellum possibly being fused with eusternum, its lateral part or Laterosternellum with the large lobe, which carries coxa. The Poststernellum (*post*) of mesothorax is, in genera as *Enoclerus*, subtriangular, large, even bidivided by a transverse line, but small in genera as *Monophylla;* the poststernellum of metathorax is small and developed as intersegmental membrane, with the sternal and ventral notch connected and combined to an insignificant longitudinal deepening.

The Legs are five jointed, no free claws; they are on all segments inserted widely apart, all of same size and same form and the corresponding articles, for instance all femora, are pointing in the same direction; they are medium sized, largest in comparatively free living genera, as *Cymatodera*, shortest in the white, vermiform genera, as *Orthopleura* or *Monophylla*, which permanently live in the galleries of their prey. No Trochantin developed in the skin around coxa. The Coxa (*cox*) has a projecting condyle, is short, conical, with the top obliquely cut; its base is broad, oval with the long diameter pointing backwards and inwards; the height of the outer coxal surface is as large as the length of the mentioned diameter, the height of the inner coxal surface four times shorter; the sizes of the anterior and the posterior coxal surfaces are about equal. The Trochanter (*tro*) is of medium size, with the inner and longer surface as long as the inner surface of coxa. The Femur (*fe*) is, in the shortlegged genera, as long as the long diameter of the coxal base, in the other genera twice as long; its dorsal side is convexly curved; usually it is stretched for-

ward. The Tibia (*tib*) is about as long as femur; dorsally convexly curved; directed forward. The Tarsus (*ta*) is clawshaped, probably fused with a claw, slightly curved and pointed, of medium size, except in *Hydnocera*, where it is small.

The Abdomen is straight and fleshy, varying in general appearance. It may be subclaviform as in *Thaneroclerus* and *Orthopleura*, or digitiform as in *Enoclerus* and *Cymatodera*, or vermiform as in *Monophylla* and *Neichnea*, this variation mainly due to whether most of the abdominal segments have the same size or not, whether postscutellum is large or small, and whether the areas which constitute the intersegmental membranes form an expanded or narrow band. The number of the abdominal segments is 10; the first to eighth segments have laterally placed spiracles; the ninth is without any spiracles and usually carries cerci; the tenth is pierced by the anal opening.

Notches (*Nodi*).—The abdominal notches are located between the segments as described between the metathorax and the first abdominal segment; as here the sternal notch is predominant to the ventral notch, which latter is faintly indicated and fused with the sternal notch or totally absent; the pleural notch is much closer to the lateral notch than in the thoracic segments and not so pronounced; in genera with long abdomen and large intersegmental membranes the dorsal and lateral notches are developed as short longitudinal lines and not as pits.

Sutures.—The dorso-lateral sutures between the dorsal notches and below the spiracles are well defined in all forms except *Orthopleura*, where all sutures are very faint. Anteriorly, behind the pre-epipleural arm, and posteriorly, in front of the post-epipleural arm, the suture is nearly perpendicular; medianly, between the alar area and the epipleurum, horizontal and straight. The ventro-lateral sutures between the lateral notches are horizontal and straight; anteriorly, between a lateral and pleural notch and above presternum, the ventro-lateral suture is faintly indicated or even evanishing, as described in thorax, but posteriorly, above hypopleurum, deeply marked. The scuto-scutellar suture is well developed and provided with an anterior and posterior oblique branch; in *Necrobia* and other forms even a ventrally directed branch is present in direct continuation of the main suture. That suture which defines postscutellum anteriorly is straight, rather perpendicular, and the suture which marks the dorsal boundary of the alar area branches out from it in an oblique forward and ventral direction. In *Necrobia* a deep, transverse suture separates a large preeusternal area from the eusternal area; this suture is not, or only faintly, developed in the other genera. Another transversal suture separates eusternum from mediosternellum. Two oblique

and parallel sutures extend from this latter suture; the one, from near the middle, points forwards and outwards, the other, from the end, points backwards and inwards; the first forms the inner boundary line of parasternum (*pas*), the second the inner boundary line of laterosternellum (*lstl*).

Areas.—The Tergal region is limited by a transversal, straight front margin between the two corresponding dorsal notches in front of a segment, by U-shaped side margins between two successive dorsal notches and by a transversal straight hindmargin between the two corresponding dorsal notches behind the segment. The Prescutum (*psc*) is transverse and band-like, mainly developed as intersegmental membrane (*T S*); in most genera narrow and rather indistinctly defined posteriorly, in genera with long abdomen broad and distinctly defined posteriorly. The Scutum (*sc*) and Scutellum (*scl*) have distinct mediotergal subdivisions, which form together a conspicuous Mediotergite. In a few forms, as *Enoclerus sphegeus*, a row of small, pearl-shaped projections are present on each side of the scuto-scutellar suture, and also along the two oblique branches from this suture. In several forms as *Galeruclerus*, *Chariessa*, *Phyllobaenus*, and *Priocera* a pair of Ampullae (*Amp*) develops from the mediotergite of the second to the seventh or eighth abdominal segments. The lateral subdivisions of scutum and scutellum are more or less fused into a combined area, named Parascutum (*pa*). The Alar Area (or Spiracular Area) (*aa*) is large, with a spiracle present anteriorly and near the dorso-lateral suture. The Postscutellum (*pos*) is of medium size in most forms; large in elongate forms. The Pre-epipleural Area (*pe*) is completely or nearly completely developed as intersegmental membrane; in most genera it is elongate, triangular, tapering toward the dorsal notch; in genera as *Monophylla* and *Tarsostenus*, where the dorsal notch is linear, it is subrectangular, ventrally with a short wedge-shaped cut into the basal margin. The Median Epipleural Area, between the horizontal section of the dorso-lateral suture and the ventro-lateral suture, is in most genera provided with a large Epipleural Lobe (*el*). The Post-epipleural Area (*poe*) is triangular and posteriorly adjacent to the pre-epipleural area of the next segment. No pleural disks are found.[1] The Hypopleurum (*hp*) is dorsally well defined by that part of the ventro-lateral suture, which is behind the pleural notch; ventrally not equally distinctly separated from the adjacent areas; it is fleshy and well developed in most forms. The abdominal Presternum (*pst*) is, like in thorax, located below that part of the ventro-lateral suture,

[1] The anatomy of these structures has been described first (1869) by Schiödte as "foveae auditoriae" (Nath. Tidsskr., ser. 3, vol. 6, pp. 356, 366, etc.), later (1917) by W. N. Hess, (The Chordotonal Organs and Pleural Discs of Cerambycid Larvae; Ann. Ent. Soc. Amer., vol. 10, No. 1, pp. 63–74, pls. 4–7) and by him also associated with chordotonal organs.

which is anterior to the pleural notch, but is here a small, triangular structure, and does by far not reach the ventral middle line of the segments. A distinct Preeusternum is not developed except in *Necrobia* and, less pronounced, in some species of *Enoclerus*. Eusternum (*es*) is large, subtriangular, without any longitudinal muscle impression in front of parasternum. Parasternum (*pas*) is well defined, subtriangular, with straight interior limitation. The Mediosternellum (*mstl*), posteriorly ending at the sternal notch, has normally the shape of a small, narrow, transversal band with lanceolate or subtriangular outline; it is unusually large and swollen in *Tarsostenus*. The Laterosternellum (*lstl*) is in most genera small, even indistinct; when well developed, as in *Enoclerus* and *Cymatodera*, it reaches the sternal notch and has a shape similar to parasternum and limiting lines parallel to those of that area. The Poststernellum (*post*) lies behind the mediosternellum and laterosternellum of the segment and in front of the presternum and eusternum of the next segment; it is developed as intersegmental membrane; usually of moderate size, but large in the elongate, vermiform genera. The Coxal Lobe is between hypopleurum, parasternum, and laterosternellum; it is small, often indistinct and confluent with parasternum.

The ninth abdominal segment consists of a large dorsal region, containing both tergal and epipleural elements, and a narrow bandlike ventral region with hypopleural and sternal elements; the two regions are separated by the ventro-lateral suture; none of them are differentiated into special areas. In the different species of the large genus *Enoclerus* and also in many other genera, a pair of solid, usually not branched, well-developed Cerci (*cer*, fig. 79) extend from an unpaired, chitinous basal plate (*bp*) on the dorsal region; the shape and size of both cerci and basal plate vary considerably in the family. In *Necrobia* the cerci are slightly branched; in some species of *Cymatodera*, as *Cymatodera bicolor*, they unite into a single, bifurcate, stalk-like formation, which arises from a well-developed disciform basal plate; in *Priocera castanea* the cerci are small and fused into a bifid, conical horizontal prolongation of the basal chitinization, which in this form envelops the whole dorsal region; in *Thaneroclerus girodi* the cerci are rudimentary, but the basal plate is well developed; in *Hydnocera* the cerci are rudimentary and the basal plate is not sharply defined; *Phyllobaenus* and *Orthopleura* have a pair of hook-shaped cerci, but no basal plate, and *Neichnea* has neither cerci nor basal plate.

The tenth abdominal segment is developed as a locomotive organ and placed entirely below the ninth segment; it is wart-shaped, ringlike with a triangular anus, which is surrounded by four small papillae in front and one large, lip-like lobe behind.

The Spiracles (*sp*) vary considerably in the family and provide a character of high systematic value. The genus *Necrobia* has large, annular-bifore spiracles with circular peritrema and well-developed, finger-shaped tubes. *Thaneroclerus*, a genus distinctly different from all other genera in the family, has small annular-bifore spiracles. The genera *Enoclerus*, *Galeruclerus*, and others, have pseudo-annular spiracles, which means that the spiracles only apparently are ring-shaped, but in reality, as seen with high power magnification, annular-bifore with a pair of very small finger-like tubes extending backwards from the posterior margin of the ring-shaped peritrema. In a few species of *Enoclerus* the posterior abdominal spiracles are annular-bifore, thus indicating the rather close relationship between the two genera *Enoclerus* and *Necrobia*. Finally, in genera as *Cymatodera*, *Priocera*, *Hydnocera*, and others, the spiracles are all plain annular. The first thoracic spiracle is mesothoracic; usually of the same size or not much larger than the abdominal ones; in *Thaneroclerus* twice as large. The second thoracic spiracle is metathoracic; always rudimentary.

The setae vary much in size, distribution, and number, according to the different genera, species, and even, age stages; they are most normally developed on all body parts in genera as *Enoclerus* and *Cymatodera;* very long, soft, and numerous in *Trichodes;* short, fine, and scarce in forms as *Orthopleura* and *Neichnea.*

The color is varying; all known species belonging to the genera *Necrobia*, *Enoclerus*, *Galeruclerus*, *Cymatodera*, *Trichodes*, and *Thaneroclerus* are vividly colored, red or blue, changing in the same genus according to species or even according to the different larval stages of the same species; in *Enoclerus thoracicus*, *Galeruclerus*, and *Cymatodera* the colored parts are speckled with white or light spots, mainly corresponding to muscle attachments; in *Necrobia* and *Cymatodera* are found on most of the segments a pair, or a transverse series of four orange dots, which probably indicate glands; genera as *Chariessa* or *Phyllobaenus* have a faint, bluish tinge on protuberant structures as the ampullae or the epipleural lobes; genera as *Monophylla*, *Orthopleura*, and *Priocera* are plain whitish; in the genus *Hydnocera* both spotted and unicolored whitish species occur.

C. CLASSIFICATION OF THE LARVAE OF NORTH AMERICAN CLERIDAE.

Preceeding the discussion on the above given subject, it is thought proper to formulate the following general principles, to which I adhere. The classification of the Coleoptera, which is based entirely on adult characters, should not be materially interfered with by taxonomic studies on a single group of larvae. A new systematic name should only in exceptional cases be applied to families, genera, and species which are established exclusively on larval characters.

A reconstruction of the present classification with due regards to the larvae should not be undertaken before an independent, comprehensive classification of all significant larval types is completed.

Usually the results of taxonomic studies on the larvae do harmonize with some or other system already used or proposed for the adults, thus emphasizing the value of that particular system. In several cases, however, certain larvae or larger groups of larvae do not fit into the schemes of any established system and for such larval forms a new appropriate taxonomic arrangement will have to be assigned in papers exclusively dealing with larvae.

In an obvious way the Clerid larvae represent this latter type of larval forms, and the classification of the Clerid larvae will clearly illustrate how much a taxonomic arrangement of the adults and the corresponding larvae can differ. The customary systematic sequence of the genera of the adult Clerids has been changed in the classification of their larvae; one of the genera which in the adults is considered homogenous must be divided in the larval taxonomy; while in another case two genera which are separated in the adults have been united in the arrangement of the larvae; and finally the Clerid larvae have been grouped together with larvae of other families to form a new series to which no corresponding series exists in the adult taxonomy.

C. *a*. LARVAL CHARACTERS DEFINING THE FAMILY SERIES CLEROIDEA.[1]

The family Cleridae is, according to the adults, by most authors placed in the family series Serricornia, but the Clerid larvae can only be associated with the larvae of part of the families of the Serricornia, namely with those of the Malachiidae, Malacodermidae, Throscidae, Eucnemidae, Rhipiceridae, and the Elateridae. They are, however, also closely related to the larvae of some of the families which belong to the series Clavicornia, namely the Dermestidae, the Trogositidae, and the Parnidae; so are the larvae of the other mentioned Serricornia. Together all these families constitute a series for which I propose the name Cleroidea and which is defined by the following combination of characters:

1. LEGS WITH FUSED TARSUS AND CLAW, "CLAW-SHAPED TARSUS."

This character separates the Cleroidea from the Adephaga with the Gyrinidae, from the Rhysodidae and the Cupesidae, all of which have a definite tarsus and one or two claws; also from the first larval stage of the Micromalthidae, close to the Cupesidae, which have a long, slender tarsus and two claws, and apparently from the first or triungulin stage of some of the Meloidae. The Staphylinid genus

[1] The following taxonomic discussion is based on a joint study on the characterization of Coleopterous larvae families, undertaken by Dr. F. C. Craighead and the author, A. G. Böving.

Bledius and Pselaphid genus *Euplectus* have tarsus and one claw, but the other genera of these two groups have fused tarsus and claw. Eucnemids have rudimentary or no legs, but are, through *Throscus dermestoides*, which has well-developed legs, allied to the other Cleroidea.

2. VENTRAL MOUTHPARTS FORM A COMPACT UNIT. MAXILLARY STIPES IMMOVABLE OR MOVABLE PRINCIPALLY IN DORSO-VENTRAL DIRECTIONS. GENERALLY EITHER WITH A SINGLE, OFTEN MORE OR LESS DISTINCTLY TWO JOINTED MALA, OR, WHEN BOTH LACINIA AND GALEA ARE PRESENT, WITH GALEA DEVELOPED AS THE MORE SIGNIFICANT OF THE TWO ORGANS, PALPIFORM AND BIARTICULATE; LACINIA USUALLY TRIANGULAR AND SQUAMOSE. MAXILLARY ARTICULATING AREA SMALL OR ABSENT. PREGULAR PLATE [1] NOT PRESENT.

This character excludes the Cleroidea from those Coleoptera larvae which have either a free stipes with turning rotatory motion and a large pregular plate, or, attached stipes, movable only in horizontal plane, and usually a large maxillary articulating area. The first alternative applies to a series formed by those larger Staphylinid forms which are represented by genera like *Philonthus* or *Stenus*, by the family Histeridae, the Hydrophilid genus *Helophorus*, that Hydrophilid type which is represented by genera like *Hydrous* or *Sphaeridium*, and by the family Paussidae. The second alternative applies to most Coleopterous families, but is especially worth emphasizing in reference to the small Staphylinids of the *Oxytelus-Tachinus-Syntonium* type, the larger Silphids of the *Silpha-Necrophorus* type, and the Byrrhidae, all of which, in many other respects, are families closely related to the Cleroidea. The small Staphylinids have a single mala; the larger Silphids two malae, lacinia large and rounded, galea short, barbate, and not jointed; the Byrrhidae two malae, lacinia large and falciform, galea elongate and more or less distinctly biarticulate.

3. MANDIBLES POSTERIORLY WITHOUT MOLA; DECREASING IN WIDTH FROM BASIS TO DISTAL END.

This type of mandibles includes the labidomorphic, grasping, mandibles, which are somewhat flattened, triangular, or falciform,

[1] The term "Pregular plate" was introduced in 1909 by Dr. A. D. Hopkins (in his publication on *Dendroctonus*) for an identical structure in adult Coleoptera (U. S. Dept. Agr., Bur. Ent., Tech. Ser. No. 17, 1909, pp. 10–19). A Kemner, in a very interesting and instructive discussion on the term *Hypostoma* (in his previously quoted publication pp. 2–3) describes (1912) the pregular plate as "Mental Platte," stating, however, that very likely "it might be a submental structure" (compare Kemner, fig. 14 with explanation). In the Staphylinid larvae, described by Kemner, the plate in question evidently contains both submental and pregular elements and might therefore shortly have been named "Submental platte" ; but in other forms, for instance the Hydrophilid larvae *Berosus* and *Helophorus* (compare Schiödte's figures of these larvae), the pregular plate (Kemner's "mental platte") appears clearly destitute of any submental element, submentum here being present as a distinct area. Consequently the term "Pregular plate" must be adopted as being both the more practical, more correct, and older term. It might be advisable here to point out that it is only in the *Carabids* that Schiödte applies the term "Hypostoma" to the postmaxillary part of what I, following Hopkins (not Schiödte, as Kemner states), term *Hypostoma*. In all other descriptions Schiödte applies this term *Hypostoma* indiscriminately to *Submentum* and *Gula*. When submentum and gula (or pregula) are fused, Schiödte mentions this joint formation as Hypostoma; when they are separated, he makes a distinction between the Anterior and Posterior Part of Hypostoma, never using the terms Submentum and Gula.

often provided with retinaculum, and the subulate mandibles, which are awl-shaped, curved, without retinaculum and often perforated. Both the labidomorphic and the subulate mandibles are rather characteristic for the Cleroidea, but do also occur in several families not belonging to this series; for instance: The Adephaga, the above mentioned small Staphylinids, large Silphids, the Rhysodidae, the Cioidae, the Lyctidae and Ptinidae, some Chrysomelidae, as the Donaciini, and some of the Melandryidae. The character separates the Cleroidea from the larvae with palmate[1] mandibles, as in most Chrysomelidae, with coelate, gouge shaped[1] mandibles, as in the Cerambycini, and especially from all larvae with masticomorphic, grinding, mola bearing mandibles. This last, important mandible type is developed in many families which, according to the adults, always have been closely associated with one or another of the Cleroid families, but, according to several larval structures, must be considered to have less affinity with these families than generally supposed; for instance, the Cucujidae, Cryptophagidae, Byturidae, Mycetophagidae, and Coccinellidae, all of which usually are placed near the Trogositidae or the Dermestidae, also the Derodontidae, by D. Sharp, and other authors suggested to belong near the Cleridae, some Dascillid genera as *Dascillus*, and the Cyphonidae, often arranged near the Parnidae, between the Elateridae and Malacodermidae. Masticomorphic or grinding mandibles are furthermore present in a great many families, which do not exhibit any close relationship to the Cleroidea, neither as adults nor as larvae; for instance, the very uniform series of small, closely related forms of the galea-bearing *Choleva*, *Limnebius*, *Hydroscapha*, *Trichopteryx* types or most of the Heteromera or all the Lamellicornia.

4. BODY ORTHOSOMATIC, STRAIGHT WITH DORSAL AND VENTRAL SURFACE EQUALLY LONG OR NEARLY SO; OR BODY CYPHOSOMATIC, WITH THE WHOLE DORSAL SURFACE FORMING A HUMP. INTERSEGMENTAL MEMBRANES PRESENT. TENTH ABDOMINAL SEGMENT USUALLY DEVELOPED AS A LOCOMOTORY ORGAN, EXTENDING FROM THE VENTRAL SIDE OF THE NINTH ABDOMINAL SEGMENT.

This character separates the Cleroidea from the cyrtosomatic, curved larvae, as those of the Bostrichidae, Ptinidae, Donaciini, most Rhynchophora, and the Lamellicornia.

5. NO THORNBEARING DORSAL PLATES.

Such structures characterize many different species and genera, even larger groups of several families not included in the Cleroidea, but do hardly occur in this series.

[1] Palmate and coelate mandibles are anteriorly broad, with a definite front edge, on the inner side excavate, posteriorly without mola. In the palmate mandibles the front edge is multidentate; in the coelate mandibles smooth.

6. CERCI, WHEN PRESENT, INARTICULATE AND IMMOVABLE.[1]

This character may for purely taxonomic use be considered of minor interest, only an additional character to the above-mentioned, yet it separates the Cleroidea from several families or series of families in which most or many or some of the members have jointed and movable cerci; for instance, from most of the *Choleva*, *Limnebius*, *Trichopteryx* types; from many of the Adephaga types; many of the *Staphylinus*, *Hister*, *Helophorus* types, and many of the *Oxytelus*, *Tachinus*, *Silpha* types; from some of the Cucujidae, as the genera *Brontes*, *Dendrophagus*, and *Psammoecus;* and from a single species *Cryptophagus lycoperdi* Herbst (European) of the Cryptophagidae.

7. SPIRACLES ANNULAR OR BIFORE. FIRST THORACIC SPIRACLE PLAINLY IN PREEPIPLEURUM OF MESOTHORAX.

By this character the Cleroid larvae are separated from all larvae with cribriform spiracles—namely, the Buprestidae, the genus *Dascillus*, the Heteroceridae, and all the Lamellicornia, except *Throx*, which has bifore spiracles.

C. *b*. LARVAL CHARACTERS DEFINING THE FAMILIES OF THE CLEROIDEA AND PARTICULARLY THE FAMILY CLERIDAE.

While the above given combination of characters equally applies to all families of the series, and consequently does not classify each individual family definitely, another combination of characters fulfills that requirement and serves in that way to separate every family in the series from the rest.

The characters which particularly define the Cleridae and complete the precise determination of this family are the following:

(*a*) *Head porrect and exserted.*

(*b*) *Labrum and clypeus present.*

(*c*) *Antennae well developed and three jointed.*

(*d*) *Mandibles acuminate with single apex and usually with retinaculum; a deep groove along the cutting edge; no penicillum.*

(*e*) *Ventral mouthparts protracted or only slightly retracted; maxillary margin of hypostoma adjacent only to cardo; postmaxillary margin of hypostoma adjacent to gula and in some forms detached as a separate "paragular" structure.*

(*f*) *Cardo maxillae as large or larger than stipes maxillae.*

[1] When J. A. Hyslop in his important paper, The Phylogeny of the Elateridae, based on larval characters (Ann. Ent. Soc. Amer., vol. 10, 1917, p. 245), writes that the larvae of the Elateridae have "no cerci," he evidently does not consider inarticulate and immovable cerci as real cerci. I, however, follow Schiödte in using the term "cerci" for these structures, as I am convinced that they are homologous to the jointed, movable cerci in other Coleopterous larvae. In the family Carabidae both forms of cerci occur in genera intimately connected, as *Notiophilus* and *Elaphrus*; in fact, even in different species of the same genus, as in the Carabid genus *Chlaenius*, one species, from North Africa, deposited in the Zoological Museum of Copenhagen, has long, jointed, movable cerci, while all the Danish species have stiff, straight cerci. Also in the same Cryptophagid genus *Cryptophagus*, one species *C. lycoperdi* has jointed cerci, while *C. pilosus*, *C. pubescens* and others have solid cerci.

(*g*) *Palpus maxillae with three free joints and a low, not joint-like palpiger, which is closely connected with stipes.*

(*h*) *Mala maxillae*[1] *extending from the distal end of stipes; simple or transversely bisected.*

(*i*) *Maxillary articulating area absent.*

(*j*) *Submentum well defined.*

(*k*) *Gula as long as frons, elongate, rectangular, limited by two parallel gular sutures.*

(*l*) *Prothorax usually with two well-separated presternal plates and an unpaired median sternal plate.*

(*m*) *Abdominal segments fleshy, plicate, without chitinous shields, often ivvidly colored and often with ampullatory lobes.*

The above given combination of characters shows the Cleridae as a comparatively simple larval type. This type, however, does not represent the one from which the other Cleroidea have developed. In fact, the Cleridae must be looked upon as a derived family in the series and developed from the same group of families, the Malachiidae, Dermestidae and Trogositidae, from which probably the whole series, except the Parnids, directly or indirectly has branched.

In general organization the Cleridae are most like the Malachiidae. In characters, as the shape of cardo and submentum and the shape of the mandibles, the Cleridae come nearest to the Malachiidae and Dermestidae; but in other characters, as the well-developed and well-separated presternal plates and the well-defined sternal plate, which is present in the typical Clerid genera, and the occurrence of pseudoannular spiracles in some of the genera, the Cleridae approach remarkably the typical Trogositidae, for instance, the genus *Trogosita*. In common with all three families the family Cleridae has a well-developed labrum and clypeus and a gular area; but it differs from them in having protracted ventral mouthparts, as the three families, like the rest of the series, have retracted. That the gular area is elongate and as long as frons in the Clerids, but shorter than frons and usually square or transversally rectangular in the other three families harmonizes with the different position of their ventral mouthparts.

The more typical Dermestidae have a small but distinct lacinia, a two-jointed galea and a slight indication of a division of ligula into two lobes, what is a decidedly primitive character, not present in any other Cleroid; in the Malacodermidae and Elateridae ligula is even not developed. Most of the Trogositid genera have a porrect and exserted head, as the Clerids, but the Dermestidae, some of the Trogosi-

[1] John B. Smith in Explanation of terms used in Entomology, Brooklyn, N. Y., 1906, defines (p. 77) "mala maxillae" as "the lobes of maxilla; outer or galea, inner or lacinia; where only one is present, the term refers to that one." In the Cleridae only one lobe, questionable if lacinia or galea, or both fused, is present.

tidae and, to a less extent, the Malachiidae have a nutant and somewhat invaginated head and resemble in that respect both the Parnidae and the Rhipiceridae.

With the families Parnidae, Rhipiceridae, Throscidae, Eucnemidae, Malacodermidae, and Elateridae, the Cleridae are not so closely associated as with the Malachiidae, Dermestidae, and Trogositidae. This can readily be realized from the following brief morphological and phylogenetic analysis of those first mentioned families.

The Parnidae and Rhipiceridae have, as mentioned above, a nutant or seminutant head. Labrum is well developed and clypeus rather distinct; cardo broad and low; stipes maxillae broad. In the Rhipiceridae only a single mala is present; in the Parnidae a well-developed lacinia and well-developed galea. In the Parnidae, mentum has the usual quadrangular form present in most of the Cleroidea, but in the Rhipiceridae the mentum is posteriorly constricted as in some Elaterid genera. In the Parnidae the antennae are three-jointed, in the Rhipiceridae very short, retracted, one or possibly two jointed. In both families the ninth segment enables a perfect sealing of the anal opening; in the Parnidae this ninth segment is often prolonged and conical, in the Rhipiceridae operculate, convex and circular; in the Parnidae the body is terminated by three bunches of gills, in the Rhipiceridae no similar structures are present.

The Parnidae must be derived from the Byrrhids but show also relationship to the Dermestidae. The Rhipiceridae are undoubtedly closer connected with the Dermestidae and the Parnidae, especially the cylindrical Parnidae, than with the Elateridae, from which family they usually are supposed to have branched.

The Throscidae and Eucnemidae are still more remote from the original simple Cleroid type than the Parnids and Rhipicerids. The genus *Throscus*, represented by *Throscus dermestoides* Linnaeus is in many respects the prototype of the Throscid-Eucnemid group, the form from which the Eucnemidae have metamorphosed by a retrogressive development. The legs, which have disappeared in most Eucnemids, are well developed in *Throscus dermestoides*. With exception of the mandibles, which in *Throscus dermestoides* are fused with the mouth frame, but free in some Eucnemid genera, the mouthparts as well as the antennæ are less rudimentary in Throscus than in the Eucnemids. Labrum is absent in both families, only represented by a small triangular process from the epistomal margin of frons. The isolated morphological development of the group is indicated by the invagination of the head, but especially apparent in the extraordinary rodshape of the prothoracic presternal, prehypopleural, and paired sternal (more correctly sternellar) plates.

In *Throscus* the presternal plates are separate, connected with the prehypopleural rods, which interiorly continue into a long rod-like hypopleural apodeme. The anterior basal margin of coxa is separately chitinized, forming a curved rod, which posteriorly terminates as a little projecting hook. These rods are also present in the Eucnemids. The most interesting structures, however, present in both families, are the paired, rod-like sternal (sternellar) plates. Similar structures do not occur in any other Cleroid, but they have their homologa in the two strongly developed, broad plates which cover the whole ventral side of prothorax of the Buprestidae.

The Throscid-Eucnemidae constitute an isolated, highly specialized group inside the Cleroids, undoubtedly closer to the Elateridae than to any other family of the series, but on the other hand not right away to be considered a transformed and reduced Elaterid type. Rather may a strong convergence toward the Buprestidae be emphasized. In fact, the Throscid-Eucnemids can hardly be separated from this latter family by any other valid character than the different shape of the spiracles, the Buprestidae having cribriform, the Throscid-Eucnemids bifore spiracles. It may, however, be advisable to mention in this connection that, among the Cleroid, the Telephoridae exhibit a type of annular-bifore spiracles with peculiar sponge-like lateral structures, which recalls the large, crescent-shape air-chamber of the cribriform spiracles. Thus the possibility is not excluded that some form among the Cleroid might be found with cribriform spiracles or some Buprestid with annular or bifore spiracles; a discovery which would involve the Buprestidae to be placed among the Cleroidae.

The Elateridae including the Cebrionidae are one of the best studied larvae families.[1] The Malacodermidae are by far not so well known. They include groups of distinctly different appearance. Some are flat, and smoothly chitinized larvae with laterally expanded segments, others fleshy, whitish, slightly chitinized, others again darkcolored, soft, velvety pubescent. Labrum absent in all. Falciform, toothed mandibles occur in forms as *Photuris* and subulate, often perforated in forms as *Drilus;* normally developed maxillae with a single mala occur in most forms, but maxillae having stipes completely fused with a chitinized mentum exist—for instance in *Lygistopterus;* purely bifore spiracles are present in the Lampyrids, pseudo-cribiform in Telephorids; the ninth abdominal segment varies greatly according to groups or genera; it is well developed, soft, posteriorly rounded and without cerci in the Telephorids; large, chitinized with distinct, blunt ending cerci in the *Lygistopterus;* rather small, chitinized, and together with the large, cylin-

[1] See Hyslop, J. A. The Phylogeny of the Elateridae based on larval characters, Ann. Ent. Soc. America, vol. 10, 1917, p. 242.

drical tenth segment, forming an efficient pseudopod in a type as *Phosphaenus*.

The Elateridae have perhaps developed from the Trogositidae.

The relationship of the Malacodermidae is not clear. Through the Telephoridae there is some connection both with the Malachidae and the Elateridae. From the first family, however, the Telephorids are, as shown above, readily distinguished; from the Elateridae not so easily. These two families have practically all characters in common, except the shape of the spiracles; yet a close relationship with the Elaterids might be more apparent than real.

C. *c.* PHYLOGENETIC AFFINITIES OF THE SINGLE FAMILIES OF THE CLEROIDEA TO OTHER COLEOPTERUS FAMILIES.

After the previously given discussion on the systematic and phylogenetic position of the Cleridae among the families with which they directly or more indirectly are associated and the short characterization of these other families of the series and their probable phylogenetic relations to each other, it might be proper to end with a brief, partly summarizing indication of the possible affinities of the Cleroidea to other families outside this series.

The Cleroidea are connected with the Byrrhidae, the Silphidae, and probably with several of the Chrysomelid groups through the Dermestidae, possibly with the Bothrideridae through the Cleridae and Trogositidae, with the Bostrichidae, Lyctidae, and Ptinidae through the Dermestidae and Trogositidae. The Parnidae and Rhipiceridae come close to the Byrrhid-like genera *Ptilodactyla* and *Anchytarsus* and to the family Heteroceridae. The Eucnemidae are most likely connected with the Buprestidae.

C. *d.* TABLE OF SUBFAMILIES, DIVISIONS, SECTIONS AND GENERA OF NORTH AMERICAN CLERID LARVAE.

SUBFAMILY A, p. 597 (large bifore spiracles).

  Genus 1. *Necrobia*, p. 597 (two ocelli).

SUBFAMILY B, p. 599 (frons posteriorly pointed; no epicranial suture; second antennal joint small).

DIVISION I, p. 599 (5 ocelli):

 Section *a*, p. 599 (vividly colored, well-developed basal plate, gula long).

  Genus 2. *Thanasimus*, p. 601 (unicolorous, cylindrical cerci) and *Enoclerus*, p. 602 (unicolorous; cerci corniform or claviform).

  Genus 3. *Enoclerus sphegeus*, p. 604 (epicranial tubercles).

  Genus 4. *Galerucleru*s, p. 606 (spotted; with ampullae).

 Section *b*, p. 607 (slightly or not colored; basal plate poorly or not developed).

  Genus 5. *Charicssa*, p. 608 (ampullate; basal plate laterally rectilinear).

  Genus 6. *Phyllobaenus*, p. 609 (ampullate; large intersegmental membrane; no basal plate).

  Genus 7. *Neichnea*, p. 610 (no cerci).

 Section *c*, p. 611 (vividly colored; gula short).

  Genus 8. *Trichodes*, p. 611 (very hairy).

DIVISION II, p. 612 (4 ocelli):
Genus 9. *Tarsostenus*, p. 612 (ampullate; large intersegmental membrane; basal plate distinct).
DIVISION III, p. 614 (3 ocelli):
Genus 10. *Cymatodera*, p. 614 (spotted; orange punctures).
DIVISION IV, p. 617 (1 or no ocellus):
Genus 11. *Orthopleura*, p. 617 (swollen; no basal plate).
Genus 12. *Monophylla*, p. 618 (elongate; basal plate distinct).
SUBFAMILY C, p. 619 (second antennal joint large).
Genus 13. *Priocera*, p. 619 (ninth abdominal segment enveloped by conical, asperse chitinization; cerci small, fused basally).
SUBFAMILY D, p. 620 (well developed epicranial suture).
Genus 14. *Thaneroclerus*, p. 621 (median gular tubercle).
SUBFAMILY E, p. 622 (frons posteriorly with straight, transversal margin).
Genus 15. *Hydnocera*, p. 622 (apical and supplementary joints of antennae large).

C. *e*. KEY TO GENERA OF FULLGROWN NORTH AMERICAN CLERID LARVAE.

1. Frons posteriorly limited by a transverse line ... *Hydnocera*, p. 622.
   Frons posteriorly angulate ... 2
2. Epicranial suture, well developed ... *Thaneroclerus*, p. 621.
   Epicranial suture, not well developed ... 3
3. All spiracles bifore; two ocelli ... *Necrobia*, p. 597.
   Anterior or all spiracles annuliform or pseudo-annuliform ... 4
4. Antenna with large second joint; ninth abdominal segment conical, asperse, bifid ... *Priocera*, p. 619.
   Antenna with small second joint ... 5
5. One or no ocellus ... 6
   More than one ocellus ... 7
6. No basal plate; tumid body ... *Orthopleura*, p. 617.
   Distinct basal plate; elongate body ... *Monophylla*, p. 618.
7. Three ocelli ... *Cymatodera*, p. 614.
   More than three ocelli ... 8
8. Four ocelli; sixth and seventh abdominal segment ampullate; basal plate distinct ... *Tarsostenus*, p. 612.
   Five ocelli ... 9
9. Gula comparatively short, ventral mouth parts somewhat retracted, body very hairy ... *Trichodes*, p. 611.
   Gula elongate ... 10
10. Membranous parts of body with faint bluish tint on exposed areas or white; basal plate indistinct or absent ... 11
    Membranous parts strongly colored; basal plate distinct ... 13
11. With cerci ... 12
    Without cerci ... *Neichnea*, p. 610.
12. Basal plate laterally rectilinear; body finger-shaped ... *Chariessa*, p. 608.
    Basal plate not present; body elongate, worm-shaped ... *Phyllobaenus*, p. 609.
13. Body colored, with whitish pattern; chitinization of cardo occupies half or less of entire cardo surface ... *Galeruclerus*, p. 606.
    Body of one strong color throughout; chitinization of cardo occupies two-thirds or more of entire cardo surface ... 14
14. Each epicranial half with a dorsal tubercle ... *Enoclerus sphegeus*, p. 604.
    Each epicranial half without any dorsal tubercle ... 15
15. Cerci corniform, with long gradually pointed end, or clubshaped with short abruptly contracted end ... *Enoclerus*, p. 602.
    Cerci like the horn of a chamois, cylindrical with rather short, much recurved, pointed end ... *Thanasimus*, p. 601.

C. *f*. CHARACTERIZATIONS AND DESCRIPTIONS OF SUBFAMILIES, DIVISIONS, SECTIONS, GENERA, AND SPECIES OF NORTH AMERICAN CLERIDS, ARRANGED ACCORDING TO THE RELATIONSHIP OF THE LARVAE.

Subfamily A (pp. 597–599).[1]

Frons posteriorly limited by an acute angle. Epicranial suture not present. Second antennal joint small, about the same length as apical antennal joint. Ventral mouth parts distinctly exserted. Gula with flat surface. Abdominal preeusternal and eusternal areas well separated. Spiracles all well developed, all annuliform-bifore. Ocelli, two on each side.

1. Genus NECROBIA Latreille.

Body subclaviform, ventrally flattened, widest at fourth to seventh abdominal segments, tapering from here gradually toward head and the ninth segment, which is full and crescentiform. Membranous parts variegated. Setae long, rather thin, numerous, scattered. Headcapsule from middle of epistoma to end of frons as long as the extreme width of the head; sides nearly straight and parallel. Frons with slightly unequal surface. Epicranium dorsally rugose, ventrally smooth. Ocelli two on each side; the anterior more than twice as large as the posterior; anterior ocellus not farther behind pleurostoma than the length of second antennal joint; posterior ocellus placed somewhat obliquely and dorsally behind the anterior one, as far from this as the length of the same second antennal joint. Antenna with lengths of basal, second, and apical joints proportioned as 3:2:1; supplementary joints very small. Mandibles rather slender, considerably longer than wide, apex long and pointed, projecting over inner corner of mandibular base; distinct retinaculum. Maxilla well developed; both cardo and stipes with subrectangular basal chitinization, the chitinization of cardo the larger; mala bidivided, fleshy, reaching middle of second joint of maxillary palpus; palpiger with low semicircular chitinization; joints of maxillary palpus gradually decrease in thickness from basal to apical joint; lengths of basal, well-developed square chitinization between and adjacent to the chitinizations of cardines and as long as these. Mentum with curved anteriorly concave chitinization and a transverse row of four setae. Stipes labii chitinized; labial palp with basal and apical joints shaped and proportioned as second and apical joints of the maxillary palp. Gula nearly as long as frons, its length, in proportion to the

[1] It is not deemed advisable to consider as a family, corresponding to the adult family Corynetidae the present subfamily A, represented by the genus *Necrobia*. Every one of the other five subfamilies, established in the present paper, should in that case logically be raised to family rank.

length of the maxilla from condyle of cardo to end of palpus, is as 5:3. Prothoracic tergal shield along middle line about as long as one of the frontal sutures; prothoracic sternal plate broadly lanceolate. Legs medium sized. Abdomen with normally developed intersegmental membranes; scuto-scutellar suture deep, with anterior and posterior branches evanishing and with an accessory, ventrally directed, deep branch developed in continuation of the main suture; no distinct mediotergal subdivision, scutum and scutellum almost completely separated from alar area; postscutellum narrow; an anterior, large preeusternal area separated by a deep transversal suture from a small eusternal area; parasternum large, meets the corresponding opposite area in the middle line; mediosternellum and laterosternellum normally built. Basal plate of cerci large, well chitinized, anteriorly well defined, laterally rounded, somewhat expanded beyond the attachments of the cerci, covers a great part of the dorsal surface of ninth abdominal segment. Cerci paired, widely separated, rather small, each cercus with a small projection carrying two exceptionally long setae. Tenth abdominal segment prominent, with four large soft-skinned papillae in front of anus. Spiracles annuliform-bifore, with the finger-shaped tubes pointing backwards both on the thoracic and abdominal spiracles. In general appearance and many important characters *Necrobia* is closely related to the genus *Enoclerus*.

The association of the genus *Phyllobaenus* with the genus *Necrobia*, as indicated by Brues and Melander in Key to the families of North American Insects, Boston, 1915 (p. 35), is not supported by the classification of the larvae.

NECROBIA RUFIPES Degeer.

No. 486, U. S. N. M. Mature larva taken together with pupa and adult.

Total length[1] of body, about 10 mm.; extreme width, about 2 mm.; fifth to seventh abdominal segments widest; anterior width of prothorax one-half the width of the seventh abdominal segment; extreme thickness, 1½ mm.; seventh abdominal segment thickest. Corneous parts shiny, brown ocher[2]; delicately chitinized parts shiny, pale clay yellow; membranous parts of thorax and abdomen dorsally mauve or lilac with white muscle attachments, ventrally whitish with bluish pattern; while alive probably with four small round conspicuous red marks in a transverse row on the dorsal side of most segments.[3] Frons rugose, anteriorly on each side of middle line

[1] The Clerid larvae vary individually considerably in size, according to the food conditions. The measures given for each species refer as a rule to the type specimen mentioned.

[2] For nomenclature of colors see John B. Smith in his Explanation of terms used in Entomology, 1906.

[3] According to A. Kemmer (see bibliography), such punctures are found in living specimens of the two *Necrobia* species studied by him, but disappeared in specimen preserved in alcohol.

with a shallow deepening. Labrum three times as wide as long; width about one-third the length of frons. Mandibles half as long as frons; length to width as 4:2; retinaculum and tooth same size, are well developed and rather obtuse. Two short mandibular setae. Prothoracic shield two-thirds as long as wide, with parallel sides. Both meso- and metathorax are about as long as prothorax, surpass it one-third or more in width; metathorax a trifle wider than mesothorax; meso- and metathoracic dorsal plates present, small and about the same size. Basal plate of cerci a trifle wider than the prothoracic shield, length to width as 2:3. Cerci one-third the length of basal plate, upwards curved, diverging about 60°.

Subfamily B (pp. 599–619).

Frons posteriorly limited by a sharp angle. Epicranial suture not present. Second antennal joint small, about same length as apical antennal joint. Ventral mouthparts exserted or slightly retracted. Gula with flat surface. Abdominal preeusternal and eusternal areas[1] not separated. Spiracles pseudo-annuliform or annuliform.[1] Ocelli 5, 4, 3, 1, or none on each side.

DIVISION 1 (pp. 599–612).

Ocelli 5.

SECTION A (pp. 599–607).

Body digitiform with extreme width on fourth to seventh abdominal segments, tapering from here gradually anteriorly and posteriorly, ninth abdominal segment crescentiform; dorsally without ampullae, except in one form, *Galeruclerus;* ventrally flattened. Chitinous parts numerous, well developed and with deep brown color prevalent. Membranous parts strongly colored. Setae as a rule rather numerous, scattered. Headcapsule comparatively large, subrectangular, about as wide as long; hypostoma, between articulations of mandible and cardo, straight. Mandible longer than wide; retinaculum at or near middle of mandibular inner margin. Maxilla usually with extensive chitinization of stipes and cardo. Mentum and submentum usually with well developed chitinizations. Gula longer than maxilla from end of cardo to end of palpus. Prothorax subrectangular, as long as frontal suture, not twice as wide as long; prothoracic shield corneous; prothoracic sternal plate lanceolate. Meso- and metathorax with dorsal plates. Basal plate of cerci large, well chitinized; anteriorly well defined; laterally rounded. Cerci well developed, well separated.

[1] In some species of the genus *Enoclerus* a separation is indicated between abdominal preeusternal and eusternal areas. Also are the last abdominal spiracles here developed as annuliform-bifore.

2. Genus represented by THANASIMUS and ENOCLERUS ICHNEUMONEUS, E. QUADRISIGNATUS, E. QUADRIGUTTATUS, E. HUMERALIS, E. ROSMARUS, E. MUTTKOWSKII.

Membranous parts unicolorous. Setae rather numerous, scattered. Head with slightly curved sides, about as thick as long. Frons sculptured. Epicranium dorsally rugose without protuberance, ventrally rugulose. Ocelli arranged in two subparallel, upwards and backwards directed rows; anterior row with three, posterior row with two ocelli, all of same size; distance from pleurostoma to the anterior row as long as the basal joint of the antenna and to the posterior row as long as basal and second antennal joints together; upper posterior ocellus a trifle above upper anterior ocellus, lower posterior ocellus a trifle below. Antenna with the length of basal, second, and apical joints proportioned as $2\frac{1}{2}:1:1$; supplementary joint very small. Mandible with retinaculum well developed, at or near the middle of inner margin; in some species with a tooth between retinaculum and tip of mandible. Maxilla well developed; length from condyle of cardo to end of maxillary palpus in proportion to gula as $3:5$; both stipes and cardo with large subrectangular basal chitinizations, the chitinization of cardo occupying two-thirds or more of the whole cardo surface; maxillary palpus with joints gradually decreasing in thickness from basal to apical joint; length of basal, second, and apical joints proportioned as $1\frac{1}{3}:1:1$; chitinization of palpiger semicircular. Submentum with well developed square chitinization between and adjacent to the chitinization of the cardines and as long as these. Mentum with small transverse chitinization and four setae. Stipes labii chitinized; labial palpus with basal and apical joints shaped and proportioned as second and apical joints of maxillary palpus, and about as long and thick as these. Prothoracic tergal shield, with length to width as $1:1\frac{1}{2}$, along middle line about as long as frontal suture; prothoracic sternal plate narrowly lanceolate. Legs medium sized. Abdomen with normally developed intersegmental membranes; no dorsal ampullae; scuto-scutellar suture entire, rather deep, with anterior and posterior branches distinct; inferior branch usually indistinct; with slightly developed or no asperities along the end of scuto-scutellar suture and its branches; postscutellum normal. Spiracles pseudo-annuliform.

The larvae of the different species of *Thanasimus* are congeneric with those species of *Enoclerus*, which belong to the present genus 2, as they have in common all the above-mentioned characters. It is not considered advisable to maintain, in conformity with the adult classification, a separate genus *Thanasimus*, even if all available species of *Thanasimus* admittedly have cylindrical cerci with re-

curved, not contracted apex, while the *Enoclerus* species in question have differently built cerci. In general it may be said that in the family Cleridae the form and the position of the cerci can not be used as a character of generic, only of subgeneric or specific value. This is particularly apparent in the present genus, as the different species of *Enoclerus*, which unquestionably belong here, are to be separated into two subgenera just according to two different types of cerci. Instead of making *Thanasimus* a special genus it will logically be placed as a subgenus of genus 2, equivalent to the two other subgenera.

These three *Subgenera* are characterized as follows:

Cerci cylindrical, with recurved, not contracted apex .... Subgenus 2*a* (*Thanasimus*).

Cerci conical with long gradually attenuated and slightly recurved apex, or subcylindrical, distally slightly swollen and slightly contracted apex .... Subgenus 2*b* (*Enoclerus ichneumoneus*, *E. quadrisignatus*, *E. quadriguttatus*, *E. humeralis*).

Cerci subcylindrical, distally swollen, with short abruptly contracted, dentiform apex .... Subgenus 2*c*. (*Enoclerus rosmarus*, *E. muttkowskii*).

Subgenus 2a.

(Figs. 79, 80.)

THANASIMUS DUBIUS Fabricius.

(Figs. 44–46, 79, 80, 103, 111, 122.)

No. 1795, U. S. N. M., Marquette, L. S. Mature. Species reared; imago preserved.

Total length, 13 mm.; extreme width, about 2½ mm.; anterior width of prothorax more than two-thirds of the extreme width. Corneous parts shiny, Roman sepia; delicately chitinous parts shiny, brown ocher; membranous parts purplish, ventrally paler. Setae rather delicate, comparatively long and numerous. Frons with two low and flat, cushionlike longitudinal elevations, one behind the other on each side of head, and a shallow groove behind angulus frontalis. Mandible robust; from apex to attachment of retractor tendon five-sevenths the length of frons: length to width as 8½:6; apex right above inner angle of mandibular base; retinaculum at the middle of inner margin; margin between retinaculum and end of apex entire; two mandibular setae. Meso- and metathoracic dorsal plates well developed, the metathoracic being a trifle smaller. Basal plate of cerci about same length as frons, a trifle wider than long. Cerci cylindrical, somewhat converging, about two-thirds the length of basal plate; distance between the outersides of cerci where these

are attached, two-thirds of the length of cerci; apex turned inward, and recurved, not contracted. Spiracles well developed, finger-shaped tubes diminutive on all segments.

T. dubius is very close to the European *T. formicarius* Linnaeus (fig. 79), but *T. formicarius* is about 16 mm., with cerci very slightly converging, almost parallel, only a trifle shorter than the distance to the anterior margin of basal plate; distance between the outer-sides of the cerci where these are attached, about equal to the length of the cerci.

THANASIMUS REPANDUS Horn.

Hopk. U. S. No. 15431B; mature. Species reared; cast skin and imago preserved.

Very similar to *T. dubius* and *T. formicarius;* about 16 mm. Cerci slightly divergent, a trifle longer than distance to the anterior margin of basal plate; distance between outersides of cerci, where these are attached, about equal to the length of cerci.

Subgenus 2b.

(Figs. 81–83.)

ENOCLERUS ICHNEUMONEUS Fabricius.

Hopkins; U. S. No. 9194*q;* mature. Species reared; cast skin and imago preserved.

(Figs. 17, 31, 47, 64, 81, 125.)

Total length of body, about 11 mm.; extreme width, about 2½ mm.; extreme thickness, about 2 mm.; anterior width of prothorax a trifle less than 2 mm. Corneous parts shiny, reddish brown, delicately chitinized parts shiny, brown yellowish; membranous parts crimson, ventrally paler. Setae rather soft and long. Frons on each side with two low cushion-like longitudinal elevations, one behind the other; anteriorly a shallow groove behind angulus frontalis. Mandible from apex to attachment of tendon of retractor muscle about three-fourths the length of frons; length to width as 9:6; apex slightly projecting over inner angle of basis; retinaculum a trifle closer to tip than to basis of mandible; margin between retinaculum and end of apex entire; two mandibular setae. Hypopharyngeal plates laterally not extending beyond the bicuspidate end of the vertical arm from stipes. Meso- and metathoracic dorsal plates well developed. Basal plate of cerci about same length as frons, a trifle wider than long. Cerci about same length as basal plate, corniform, nearly parallel, distance between attachments not much shorter than length of cerci; apex not contracted, turned inward, slightly recurved. Spiracle on the eighth abdominal segment annuliform-bifore with large fingershaped tubes.

ENOCLERUS QUADRISIGNATUS Say.

Hopkins U. S., No. 12217*a*; mature. Species reared; cast skin and imago preserved.

(Figs. 48, 65, 82, 117.)

Total length of body, about 11 mm. General shape, the sculpture of frons, epicranium, and other chitinous parts and the color as in *E. ichneumoneus.* The mandible provides the only character by which *E. quadrisignatus* may be separated from *E. ichneumoneus*, as having a small, low, blunt tooth in front of retinaculum, and an apex slightly more slender than in *E. ichneumoneus.* Basal plate of cerci and cerci as in *E. ichneumoneus.*

ENOCLERUS QUADRIGUTTATUS Olivier.

Hopkins U. S. No. 5998F*b*; mature. Species reared; cast skin and imago preserved.

(Figs. 49, 66, 83.)

Total length of body, about 9 mm. General shape, the sculpture of frons, epicranium, and other chitinous parts as in *E. ichneumoneus.* Color of corneous parts Roman sepia to brown ocher; delicately chitinized parts pale clay yellow; membranous parts purplish. Setae rather delicate, comparatively long, and copious. Mandibles with apex slightly projecting over the mandibular basis; retinaculum a trifle closer to the basis than to the end of the mandible; margin between apex and retinaculum serrate. Basal plate of cerci about as long as frons. Cerci about same length as basal plate with recurved, slightly contracted apex and slightly swollen below apex.

ENOCLERUS HUMERALIS Schaeffer.

Hopkins U. S. No. 12538*b*; mature. Species reared; imago preserved.

Total length of body, about 11 mm.; general shape, sculpture and color of chitinous parts as in *E. ichneumoneus.* Membranous parts pink. Basal plate of cerci about same length as frons. Cerci shorter than basal plate; proportion between length of median line of basal plate and length of cerci as $1\frac{1}{2}:1$; cylindrical, rugose, not swollen near apex; apex contracted; space between cerci horseshoe-shaped.

Subgenus 2c.

(Figs. 84, 85.)

ENOCLERUS ROSMARUS Say.

Hopkins U. S. No. 100771; mature. Species reared; cast skin and imago preserved.

(Figs. 50, 67, 84.)

Total length of body about 7 mm. General shape, the sculpture of frons, epicranium, and other chitinous parts as in *E. ichneumoneus.* Color of the corneous parts rather characteristic, head burnt sienna,

prothorax anteriorly and medianly burnt sienna, posteriorly Roman sepia, meso and metathoracic dorsal plates Roman sepia, basal plate of cerci burnt sienna with four longitudinal lines of sepia, cerci burnt sienna; delicately chitinous parts pale brown; membranous parts purplish. Mandible more robust, not so pointed as in the above-described different species of *Enoclerus;* length to width as 8½ : 6; apex right above basis; retinaculum at the middle of the mandibular inner margin; in front of retinaculum with a low, blunt, diminutive tooth. Basal plate of cerci about as long as frons. Cerci nearly as long as basal plate, diverging from each other about 50°; distally subcylindrical; on inner and lower side swollen like a heel; apex short, dentiform, abruptly contracted.

ENOCLERUS MUTTKOWSKII Wolcott.

Hopkins U. S. No. 11847*n; mature.* Species reared; cast skin and imago preserved.

(Figs. 18, 51, 68, 85.)

Total length of body, about 11 mm. General shape as in *E. ichneumoneus;* sculpture of frons, epicranium, and other chitinous parts more prominent than in the foregoing species. Color of corneous parts sepia; delicately chitinized parts pale yellowish; membranous parts dorsally bluish green, ventrally lavendar to cobalt blue. Mandibles of same. comparatively blunt type as in *E. rosmarus;* apex situated just above inner angle of base; retinaculum a trifle closer to the tip than to the base of mandible; margin between retinaculum and apex entire. Basal plate of cerci about as long as frons. Cerci about same length as basal plate, parallel, subcylindrical, distally spherically swollen; apex short, abruptly contracted, dentiform, somewhat inwardly and a trifle forwardly curved.

3. Genus represented by ENOCLERUS SPHEGEUS Fabricius.

The larvae of the present form which, according to the adult, is considered a mere species of the genus *Enoclerus*, is so deviating in several characters from the above-mentioned larvae of this genus that it must be treated as a separate genus.

Membranous parts almost unicolored. Setae well developed, numerous, scattered. Head with nearly parallel sides, rather flat; proportion between thickness and length of head as 10 : 14. Corneous parts heavier than in any of the formerly mentioned forms; this especially applies to the chitin of the headcapsule. Frons with unequal surface. Epicranium dorsally and adjacent to the median part of frontal suture with a conspicuous, rounded protuberance, which is more than half as large as the mandible. Ocelli arranged as in genus 2, except that the anterior and posterior rows are straight parallel. Antenna with length of basal, second and apical joints about as 3 : 1 : 1; together the joints are more than half as long as the

mandible; supplementary joint small. Mandible considerably longer than wide; retinaculum well developed, closer to the end than to the base of mandible; no tooth above retinaculum. Distal half of ventral mouthparts more obliquely upward directed than in any of the forms of genus 2. Maxilla very well developed; length from condyle to end of palpus in proportion to gula as 4:5; both stipes and cardo with a subrectangular chitinization, that of cardo about twice as large as that of stipes and about three-fourths of the whole cardo. Maxillary palpus with joints gradually decreasing in thickness towards apex; length of basal, second and apical joints proportioned as 1⅓:1:1; chitinization of palpiger semicircular. Submentum with well developed square chitinization between, adjacent to and as long as the chitinizations of the cardines. Mentum with small, transverse chitinization and four setae. Stipes labii chitinized; labial palpus with basal and apical joints as long and thick as second and apical joints of maxillary palpus. Prothoracic shield along middle line somewhat shorter than frontal suture; prothoracic sternal plate lanceolate. Legs of medium size. Abdomen with normally developed intersegmental membranes; no dorsal ampullae; scuto-scutellar suture entire, rather deep, with anterior and posterior branches distinct, inferior branch indistinct; second to eighth abdominal segments with well marked asperities on each side along the end of scuto-scutellar suture and its anterior and posterior oblique branches; postscutellum normal. Spiracles pseudo-annuliform.

ENOCLERUS SPHEGEUS Fabricius.

Hopk. U. S. No. 11936; mature. Species reared; cast skin and imago preserves.

(Figs. 4, 19, 32, 52, 69, 86, 104, 115, 116, 117, 119, 121.)

Total length of body, about 20 mm.; extreme width, about 3½ mm.; extreme thickness, about 3 mm.; anterior width of prothorax, about 2 mm. Chitinous parts shiny; head brownish black, other corneous parts somewhat lighter; delicately chitinized parts pale brown; membranous parts lilac, where not exposed paler and more bluish gray. Setae long and strong. Frons with median, low, broad, dagger-like longitudinal elevation and on each side with an irregularly corrugated, inversely pear-shaped field. Epicranium dorsally rugose; surface of epicranial protuberance smooth; sides with a few longitudinal lines; ventrally rugulose. Labrum more than twice as wide as long, width as large as half the length of frons. Mandible from apex to retractor tendon about three-fourths the length of frons; length to width as 10:6; apex above inner angle of basis; retinaculum closer to the end than to the basis of the mandible; margin above retinaculum entire; mandibular setae two. Hypopharyngeal plate laterally extending beyond the bicuspidate end of the vertical arm from stipes. Prothoracic shield with length to width as 2:3.

Mesothoracic dorsal plates about three times larger and considerably closer together than the metathoracic plates. Basal plate of cerci about as long as frons, a trifle wider than long. Cerci about the length of basal plate, subparallel; distance between them about half as large as their length, subcylindrical with unequal surface, directed upwards; apex recurved, not contracted, turned slightly inwards. Mesothoracic spiracle twice as large as the rest.

4. Genus GALERUCLERUS Gahan.

Membranous parts motley. Setae thin, long, not numerous. Head with slightly curved sides, as thick as long. Frons sculptured. Epicranium dorsally rugose without protuberance, ventrally rugulose. Ocelli arranged as in genus 2. Antenna with the length of basal, second and apical joints proportioned as $3:1:1\frac{1}{2}$; supplementary joint very reduced. Mandible longer than wide; retinaculum well developed, very slight indication of tooth above retinaculum. Maxilla of medium size, length from condyle of cardo to end of maxillary palpus in proportion to length of gula as 3:6; the chitinization of cardo occupies half or less of its entire surface; maxillary palpus with length of basal, second and apical joints proportioned as 1:1:2; palpiger with large, nearly jointlike chitinization. Submentum and mentum without any chitinization. Stipes labii thinly chitinized; length of basal and apical joints of labial palpus proportioned as 1:2. Prothoracic tergal shield along middle line as long as frontal suture; prothoracic sternal plate broadly lanceolate. Legs of medium size. Abdomen with normally developed intersegmental membranes; second to seventh abdominal segments with dorsal ampullae. Cerci well separated, of moderate size, subcylindrical with slightly contracted apex.

Several characters, particularly the presence of ampullae and the poor chitinization of the posterior region of the ventral mouthparts connect the present genus 4 with the genus *Chariessa* of the following section.

GALERUCLERUS OCULATUS Say (=CREGYA OCULATA Say).

Hopkins U. S. No. 10081*y*; mature. Species reared; cast skin and imago preserved.

Total length of body, 9 mm.; extreme width, 2 mm.; extreme thickness, about $1\frac{3}{4}$ mm.; anterior width of prothorax, about $1\frac{1}{2}$ mm. Chitinous parts shiny. Head sienna brown; prothoracic shield usually anteriorly sienna brown, gradually darkening into sepia on the main part of the shield, posteriorly lighter; in certain specimens, however, the shield is entirely sepia; mesothoracic dorsal plate sepia; metathoracic dorsal plate pale brown; delicately chitinized parts pale yellowish; membranous parts dorsally dark violet, with a whitish pattern corresponding to the muscle attachments; above the heart a

whitish longitudinal mediodorsal line; ventrally lighter with the whitish pattern more predominating than dorsally; intersegmental membranes whitish. Setae thin and long, light yellowish. Frons on each side with a long, linear impression from near the lateral end of clypeus and parallel with the middle line; inside of this impression and beginning near the center of frons a shorter, oblique, forward directed line, and behind angulus frontalis a very shallow deepening. Labrum more than twice as wide as long, only one-third as long as frons. Mandible from apex to attachment of retractor tendon about two-thirds the length of frons; length to width as 2 to 1; retinaculum at the middle of inner margin; tooth above retinaculum very minute or absent; two mandibular setae. Chitinization of cardo band-like, occupies less than half part of the entire surface of cardo. Meso and metathoracic plates well developed. Basal plate of cerci about same length as frons, somewhat wider than long, with four parallel rows of linear dots.[1] Cerci subcylindrical, subparallel, directed slightly upwards, about half as long as basal plate, distance between them about the same as their length, surface tuberculate; apex slightly contracted, upright, somewhat recurved and slightly turned inward.

SECTION B (pp. 607–611).

Body elongate digitiform with conical ninth abdominal segment, or vermiform with semiglobular ninth abdominal segment; dorsally with ampullae; ventrally flattened, in one genus *Neichnea* (p. 610), with protuberant sternellum. Chitinous parts moderately or even poorly developed and colored. Membranous parts tinged with pale bluish color or entirely whitish. Setae quite numerous on the chitinous, scarce on the membranous parts. Headcapsule comparatively short; subtriangular, twice as wide as long, or subrectangular not much wider than long; hypostoma slightly emarginate between the ventral articulation of mandible and the articulation of the posterior end of cardo. Mandible about as long as wide; retinaculum at the middle of the inner margin. Maxilla with a narrow, band-like basal chitinization of cardo and stipes. Mentum and submentum with very thin or without any chitinizations. Gula longer than the maxilla from posterior end of cardo to tip of palpus. Prothorax either subrectangular, about as long as frontal suture and twice as wide as long, or transverse oval, slightly wider than long; prothoracic shield delicately chitinized or absent; prothoracic sternal plate broadly pyriform. Meso- and metathorax without dorsal plates. Basal plate of cerci either delicately chitinized, anteriorly without sharp limitation and laterally rectilinear, or not developed. Cerci moderately developed or small or absent.

[1] In specimens not fully hardened the meso- and metathoracic dorsal plates are hardly to be recognized and the basal plate of cerci is slightly chitinized and without distinct marginal limitation.

5. Genus CHARIESSA Perty.

Body robust, elongate digitiform with median abdominal segments somewhat wider than the preceding and succeeding segments. Chitinous parts moderately developed with light brown color prevalent. Membranous parts with pale bluish tinge where exposed; otherwise whitish. Head subtriangular, twice as wide as long. Frons slightly sculptured. Epicranium smooth above and below. Ocelli arranged in two subparallel, upward and backward directed rows; anterior row with three, posterior with two ocelli; all ocelli approximately of same size, slightly larger than basal cups of setae; lower posterior ocellus a trifle above upper anterior ocellus. Length of basal, second and apical antennal joints proportioned as 3:1:1; supplementary joint very small. Mandible with a tooth present between retinaculum and apex.[1] Maxilla well developed, its extreme length in proportion to the length of gula as 4:5. Length of basal, second and apical joints of maxillary palpus proportioned as 2:1:1; palpiger with well-developed plate. Submentum and mentum without or with very thin chitinization. Stipes labii chitinized; basal and apical joints of labial palpus proportioned as 1:1. Prothorax subrectangular, not much longer than the following segment, twice as wide as long. Prothoracic tergal shield, with length to width as 1:2, along middle line about as long as frontal suture; prothoracic sternal plate about as wide as the distance between the attachments of the front legs. Legs of medium size. Abdomen with normally developed intersegmental membranes, second to seventh abdominal segments with dorsal ampullae; postscutellar areas well developed; sternellar areas normal. Ninth abdominal segment conical, considerably longer than half its extreme width. Basal plate of cerci conical, thinly chitinized, anteriorly not defined, laterally rectilinear. Cerci medium sized, hookshaped.

CHARIESSA PILOSA Forster.

Hopkins U. S. No. 11870*F*; mature. Species reared; cast skin and imago preserved.

(Figs. 5, 20, 33, 53, 70, 88, 89, 112.)

Total length of body, about 21 mm.; extreme width, 4 mm.; extreme thickness, 3½ mm.; anterior width of prothorax, 3 mm. Mandibles, epistoma, median endocarina of frons and the cerci blackish brown; remainder of frons and anterior part of epistoma slightly lighter, remainder of head capsule brown ocher; prothoracic shield delicately chitinized and pale clay yellow;[2] the other delicately chitinized parts also pale clay yellow; membranous parts lilac where exposed, otherwise whitish. Setae thin, light yellow, of normal

[1] In specimens near pupal stage the apex, tooth and retinaculum are often very blunt.
[2] In half-grown specimens corneous and brown ocher.

size except on the head, where many are very short and placed in small, light yellow pits. Frons with short tranversal impression behind clypeus, low and flat elevation behind the angulus frontalis, and with somewhat depressed posterior end. Mandible from apex to attachment of retractor tendon about two-thirds the length of frons; apex does not project over inner corner of mandibular base; tooth in front of retinaculum small; two mandibular setae. Hypopharyngeal plates small, elongate, slightly chitinized, laterally not extended beyond the bicuspidate end of the upward projecting arm from stipes. Basal plate of cerci with four parallel rows of linear impressions. Cerci half as long as frons, the recurved part not included, contiguous where attached, divergent forming an angle of about 30 degrees, slightly upward directed, conical, smooth with apex comparatively long, pointed and recurved.

CHARIESSA ELEGANS Horn.

Hopk. U. S. No. 1227*a;* mature. Species reared; cast skin and imago preserved.

(Fig. 87.)

Total length of body, 22 mm. Somewhat larger and more robust than *Chariessa pilosa*, but difficult to separate from this species, all examined characters, as structures, proportions, chitinizations, and color, being identical.

6. Genus PHYLLOBAENUS Spinola.

Body elongate vermiform; thoracic and abdominal segments of about same size. Chitinous parts poorly developed, brown ocher color prevalent. Membranous parts with pale bluish tinge, where exposed, otherwise whitish. Head subtriangular twice as wide as long. Frons slightly sculptured. Epicranium punctate-striate above, smooth below. Ocelli arranged as in *Chariessa* but smaller. Length of basal, second and apical antennal joints proportioned as 3:1:1; supplementary joint very small. Mandible without any tooth between retinaculum and apex. Maxilla in proportion to gula as long as 2:3; length of basal, second and apical joints of maxillary palp proportioned as 1½:1:2; palpiger with well-developed plate. Submentum and mentum without chitinizations. Stipes labii with small anterior chitinization; length of basal and apical joints of labial palp proportioned as 1:2. Prothorax subrectangular, more than twice as wide as long; prothoracic tergal shield slightly chitinized; prothoracic sternal plate about as wide as the distance between the front legs. Legs short. Abdomen with large intersegmental membranes; second to seventh abdominal segments with dorsal ampullae. Ninth abdominal segment semiglobular. Basal plate of cerci absent. Cerci small, hook shaped.

PHYLLOBAENUS DISLOCATUS Say.

Hopk. U. S. No. 11299c4; mature. Species reared; cast skin and imago preserved.

(Figs. 6, 21, 34, 54, 71, 90, 123, 127, 133.)

Total length of body, about 7 mm.; extreme width, 1 mm.; extreme thickness, 1 mm.; anterior width of prothorax, 1 mm. Mandibles, epistoma, median endocarina of frons, and cerci blackish brown; anterior part of frons, anterior part of ventral side of epicranium, chitinous bands of cardo and stipes brown ocher; rest of head delicately chitinized and pale clay yellow; legs and other delicately chitinized parts also pale clay yellow; membranous parts pale lilac where exposed, otherwise whitish. Setae whitish. Frons with short transversal impression behind clypeus, a rather deep pit near center of frons, a flat, very low elevation behind angulus frontalis; posterior end of frons depressed. Mandible about half as long as frons, apex not reaching beyond inner corner of mandibular base; two mandibular setae. Cerci (the recurved part not counted) one-fifth the length of frons, attached separately, parallel, conical, smooth, with a comparatively long, pointed, somewhat recurved apex.

PHYLLOBAENUS MERKELI Horn.

Hopk. U. S. No. 12259*a*; mature. Species reared; cast skin and imago preserved.

Length, about 9 mm.; extreme width, 1¼ mm.; extreme thickness, nearly 1½ mm.; anterior width of prothorax, nearly 1½ mm. In every other respect identical with *Phyllobaenus dislocatus*.

7. Genus NEICHNEA Wolcott and Chapin (*ELLIPOTOMA* Spinola; *ICHNEA* Castelnau).

Body elongate, vermiform, thoracic and abdominal segments of about same size. Chitinous parts very poorly developed. Membranous parts whitish. Head subrectangular, not much wider than long, with slightly curved sides, about as thick as long. Frons somewhat sculptured. Epicranium smooth above and below. Ocelli arranged as in *Chariessa*, rather well developed. Length of basal, second, and apical antennal joints proportioned as 2:1:1; supplementary joints small. Retinaculum well defined and sharp, no tooth between retinaculum and apex. Maxilla in proportion to gula as long as 4:5; length of basal, second and apical joints proportioned as 1:1:2; palpiger with chitinous plate. Submentum and mentum without any chitinization; stipes labii slightly chitinized; length of basal and apical joints of labial palp proportioned as 1:1. Prothorax suboval, slightly wider than long; prothoracic tergal shield absent; prothoracic sternal plate as wide as the distance between the front legs. Legs short and thick. Abdomen with intersegmental membranes about half as large as the segments; dorsal ampullae small, present on second to eighth abdominal segments; postscutellar areas some-

what swollen; epipleural and hypopleural areas protuberant; sternellar areas swollen. Ninth abdominal segment semiglobular. Basal plate of cerci absent. Cerci absent.

NEICHNEA LATICORNIS Say.

Hopk. U. S. No. 10762*b*; mature. Species reared; cast skin and imago preserved.

(Figs. 7, 22, 35, 55, 72, 91, 106, 129.)

Total length of body, about 7 mm.; extreme width, 1¼ mm.; extreme thickness, 1 mm.; anterior width of prothorax, 1 mm. Mandibles, epistoma, median endocarina of frons dark brown; a small anterior part of frons, anterior margin of hypostoma, chitinous parts of ventral trophi and antenna pale brown; membranous parts whitish. Setae whitish. Frons has a short, longitudinal oval deepening midway between carina and frontal suture, and in front of this deepening diverging from carina and close to epistoma a short, straight, rather deep line, which together with the opposite corresponding line limits a small, triangular, flat protuberance. Mandible about half as long as frons; apex nearly reaches beyond inner corner of the mandibular base; two mandibular setae.

SECTION C (pp. 611–612).

Body digitiform with extreme width on fourth to seventh abdominal segments, tapering from here gradually anteriorly and posteriorly; ninth abdominal segment crescentiform; dorsal ampullae not developed.

Chitinous parts moderately developed and colored. Membranous parts conspicuously colored. Setae soft, densely distributed over the whole body. Headcapsule comparatively short, subrectangular, about twice as wide as long; hypostoma with oblique, curved anterior emargination between the ventral articulation of mandible and the posterior corner of cardo. Mandible somewhat longer than wide; retinaculum considerably closer to apex than to basis of mandible. Maxilla with well-developed chitinization of cardo and stipes. Mentum and Submentum without chitinizations. Gula not longer than maxilla from posterior end of cardo to end of palpus. Prothorax subrectangular, about as long as frontal suture, twice as wide as long; prothoracic shield thinly chitinized; prothoracic sternal plate poorly chitinized, pyriform. Meso and Metathorax with dorsal plates slightly or not developed. Basal plate of cerci delicately chitinized without anterior demarcation, or not developed. Cerci short, separate.

8. Genus TRICHODES Herbst.

Frons short and wide, rather smooth; endofrontal carina posteriorly widened like an arrowhead. Epicranium dorsally and ventrally smooth. Ocelli as in *Thanasimus* and related forms (p. 600)

with upper posterior ocellus a trifle above and lower posterior ocellus a trifle below the upper anterior ocellus. Length of basal, second and apical antennal joints proportioned as $2:1\frac{1}{2}:1$; supplementary joint small. Mandible with well-defined retinaculum and a slight elevation on the inner margin between retinaculum and end of mandible. Maxilla from end of cardo to end of palpus somewhat longer than gula; length of basal, second and apical joints of maxillary palpus proportioned as 1:1:1; palpiger without chitinous plate. Stipes labii slightly chitinized; labial palpus with basal and apical joints proportioned as 1:1. Legs well developed. Abdomen with normally large intersegmental membranes, postscutellar areas of medium size; sternellar areas normal. Spiracles annuliform without any trace of fingershaped tubes.

TRICHODES ORNATUS Say.

Hopkins U. S. No. 11930*a*; mature. Species reared; larval skin preserved.

(Figs. 8, 23, 36, 56, 73, 92, 105, 128.)

Total length of body, 13 mm.; extreme width, 3 mm.; extreme thickness, $2\frac{3}{4}$ mm.; anterior width of prothorax, $2\frac{1}{2}$ mm. Mandibles, epistoma, tip of cerci dark brown; remainder of head capsule, prothoracic shield and other delicately chitinized parts pale cadmium yellow; membranous parts salmon red. Setae thin, long, yellowish. Frons hardly sculptured. Labrum more than twice as wide as long. Mandible from apex to attachment of retractor tendon about two-thirds the length of frons; length to width as 9 to 8; apex does not project over inner corner of mandibular basis; distance between retinaculum and apex of mandible one-third the length of mandibular inner margin; elevation of inner margin between retinaculum and apex slightly convex; at least seven fine mandibular setae. Basal plate of cerci poorly developed. Cerci upright, pointed, conical, slightly curved, from end to attachment less than half as long as frons.

DIVISION II (pp. 612–614).

Ocelli 4.

9. Genus TARSOSTENUS Spinola.

Body prolonged, vermiform with most of the segments of about equal size; ninth abdominal segment semiglobular; abdomen dorsally with ampullae on some of the posterior segments, ventrally rounded with protuberant sternellar areas. Chitinous parts with rather thin and light colored chitin. Membranous parts variegated. Setae scarce and thin. Head capsule comparatively small, subtriangular. Frons slightly sculptured. Epicranium smooth above and below; anterior margin of hypostoma with slight emargination. Ocelli arranged in two, upward and backward directed rows behind

the antennae; anterior row with two ocelli, posterior with two; all ocelli approximately of same size; lower posterior ocellus a trifle below, and upper posterior a trifle above the upper anterior ocellus. Length of basal, second, and apical antennal joints proportioned as 2:1:1; supplementary joint small. Mandible longer than wide, pointed; retinaculum well developed, somewhat closer to apex than to basis; no tooth between retinaculum and apex. Maxilla with thin but comparatively broad bandlike chitinization at the base of cardo and stipes; length of basal, second and apical joints of maxillary palp proportioned as 1:1:2, palpiger well developed. Gula slightly shorter than frons; somewhat longer than maxilla. Submentum and mentum poorly chitinized. Stipes labii thinly chitinized; length of basal and apical joints of labial palpus proportioned as 1:2. Prothorax rather large, with suboval outline, slightly wider than long, about one-third longer than the following segments; dorsally nearly completely covered with a shield. Sternal plate broadly pyriform, thinly chitinized, with an indistinct median lanceolate region slightly thicker chitinized than the rest. Meso- and metathorax without dorsal chitinizations. Legs normally developed. Abdomen with large intersegmental membranes; dorsal ampullae developed on sixth and seventh abdominal segments; postscutellar areas well developed; sternellar areas somewhat swollen. Basal plate of cerci covers most of dorsal surface of ninth abdominal segment, is rounded, nearly circular, thinly chitinized. Cerci well separated, medium sized, hook-shaped.

The present genus is rather closely related to the genera *Chariessa*, *Phyllobaenus*, and *Neichnea*; in many respects especially to *Neichnea*.

TARSOSTENUS UNIVITTATUS

Hopk. U. S. No. 11286*a*; mature. Species reared; cast skin and imago preserved.

(Figs. 9, 25, 37, 57, 74, 93 107.)

Total length of body, 7mm.; extreme width, about 1¼ mm.; extreme thickness, 1 mm.; anterior width of prothorax, about 1 mm. Mandibles, epistoma, median endocarina of frons, and cerci sepia brown; remainder of headcapsule and trophi, prothoracic shield, legs, basal plate of cerci from brown ocher to pale clay yellow; membranous parts violet with whitish median line and whitish muscle attachments, ventrally paler, intersegmental membranes whitish. Setae inconspicuous, whitish. Frons with a short longitudinal impression anteriorily on each side of carina, and inside of each impression an oblique line diverging forward from carina. Mandible about half as long as frontal suture, apex not projecting over inner corner of mandibular base; retinaculum somewhat closer to apex than to base; two mandibular setae. Basal plate of cerci about as long as frons.

Cerci, without consideration of the recurved part, about one-third the length of the basal plate; separately attached; distance between them about equal to their length.

DIVISION III (pp. 614–617).

Ocelli 3.

10. Genus CYMATODERA Gray.

Body robust; either digitiform with the median abdominal segments only slightly wider than the preceding and succeeding ones, or subclaviform; ninth abdominal segment crescentiform or subtriangular; abdomen dorsally without ampullae, ventrally flattened. Chitinous parts well developed. Membranous parts variegated; most segments with a row of two or four orange, round spots anterior to the scuto-scutellar suture, two on each side of median line. Setae numerous in digitiform species, scarce in subclaviform species. Headcapsule well sized, nearly square. Frons slightly sculptured, posteriorly transversally wrinkled; endocarina posteriorly widened like an arrowhead. Epicranium dorsally and ventrally with fine transversal wrinkles; anterior margin of hypostoma straight, transversal. The three ocelli large, approximately of the same size, often protuberant; their position vary according to species. Length of basal, second and apical antennal joints proportioned about as 2:1:1; supplementary joint small. Mandibles about three-fourths the length of frontal suture, somewhat longer than wide, length to width about as 8:6; retinaculum at the middle of inner margin; with or without a low elevation between retinaculum and apex. Maxilla with bandlike chitinization at base of cardo and stipes; length of basal, second, and apical joints of maxillary palpus proportioned about as 1:1:1½; palpiger well developed. Gula as long as frons; length of gula in proportion to length of maxilla as 1:1½. Submentum and mentum not chitinized; stipes labii chitinized; length of basal and apical joints of labial palpus about as 1:1¼. Prothorax subrectangular, as wide as long, about as long but not fully as wide as the following segment; dorsally with large, moderately chitinized shield; ventrally with a long, thin, subrectangular sternal plate, which in some species contains on each side a round thickening just behind and similar in size and form to the well chitinized presternal plates. Meso- and metathorax in some species with dorsal plates, the mesothoracic ones being the larger; in other species no dorsal plates. Legs comparatively long, tibia more slender than femur, clawshaped tarsal joints long and pointed. Abdomen with normally developed intersegmental membranes. Basal plate of cerci large, well chitinized. Cerci well developed, separated or fused, hook-shaped. Spiracles annuliform without any finger-shaped structures.

CYMATODERA OVIPENNIS LeConte.

Hopk. U. S. No. 9902*s*; mature. Species reared; imago preserved.

Body digitiform; total length, 17 mm.; extreme width, about 3 mm.; extreme thickness, 2 mm.; anterior width of prothorax, 1¾ mm. Mandibles, epistoma, endocarina of frons and cerci sepia brown; remainder of headcapsule and trophi, antennae, prothoracic shield, basal plate of cerci brown ocher; other chitinous parts clay yellowish; membranous parts dorsally deep violet, nearly black, with whitish spots above the heart and the muscle attachments, ventrally whitish, intersegmental membranes whitish. Setae long, rather stiff, yellow, numerous on head, legs and all segments. Frons with transversal impression behind clypeus, an oblique line defining inner margin of antennal ring and two, rather faint lines on each side of and parallel with the endocarina; posteriorly transversally rugose. Epicranium dorsally transversally rugose, ventrally smooth. The three ocelli arranged to form a right angle; anterior ocellus just behind the ventrolateral part of antennal ring, lower posterior ocellus as far behind the anterior ocellus as the length of second antennal joint, upper posterior ocellus right above the lower posterior one. Mandible with a slight marginal elevation between retinaculum and apex; two mandibular setae. Prothoracic shield transversally rugose. Meso- and metathoracic dorsal plates present, Basal plate of cerci nearly circular, somewhat longer than frons, finely wrinkled; posteriorly in the middle line with a single longitudinal deepening and on each side of middle line with three longitudinal, shallow impressions. Cerci slender and comparatively small, about one-fourth the length of the basal plate, hook-shaped with moderately recurved apex, separate, parallel, as far apart as half of their length.

CYMATODERA MOROSA LeConte.

Hopk. U. S. No. 12630*a*; mature. Species reared, larval skin and imago preserved.

(Figs. 11, 24, 38, 58, 95, 114, 124, 130.)

Very close to *C. ovipennis;* size, structural details, and color of chitinous parts as in that form. Difference only found in the color of membranous parts, these being more bluish and lighter in *C. morosa* than in *C. ovipennis*.

CYMATODERA BALTEATA LeConte.

Hopk. U. S. No. 11855*b*; mature. Species reared, larval skin and imago preserved.

Digitiform; length 11 mm. Chitinous parts dark colored, femora with two dark spots. Membranous parts purple with whitish pattern above heart and muscle attachments, ventral surface and intersegmental skin whitish. Setae numerous on head and all seg-

ments, long, rather soft, yellowish. Frons and epicranium sculptured as in *C. ovipennis*. Ocelli touch each other and are placed in a nearly straight, oblique line, parallel with frontal suture; anterior ocellus just behind ventrolateral part of antennal ring, lower posterior ocellus moved upwards into the interspace between anterior and upper posterior ocellus. Meso- and meta-thoracic dorsal plates well developed. Basal plate of cerci circular except anteriorly, where the outline is about straight; surface sculptured as in *C. ovipennis*. Cerci one-third the length of basal plate, contiguous where attached, divergent.

CYMATODERA UNDULATA Say.

Hopk. U. S. No. 12299a8; mature. Species reared, larval skin and imago preserved.

(Figs. 10, 94.)

Similar to *C. balteata* in size, chitinizations, colors, and hairiness; differs from this species only in the position of the ocelli, the shape of basal plate, and the length of cerci. Ocelli arranged in an angle of 120 degrees where the lower posterior ocellus occurs. Basal plate of cerci subtriangular. Cerci about one-half the length of basal plate, contiguous where attached and divergent as in *C. balteata*.

CYMATODERA BICOLOR Say.

Hopk. U. S. No. 10077*a*; mature. Species reared, larval skin and imago preserved.

Body subclaviform. Total length, 14 mm. Color of chitinous parts as in *C. ovipennis;* membranous parts dorsally pink to light red with yellowish or cream spots above heart and muscle attachments; ventral surface and intersegmental membranes yellowish or cream. Setae fine, long, white; numerous on head, thoracic segments, legs and ninth segment, very scarce on other segments. Frons with transversal impression behind clypeus, with a pit behind angulus frontalis, two rather faint oblique lines on each side of mediocarina, posteriorly transversally aciculate. Epicranium dorsally with fine longitudinal striation. Ocelli closely set but not touching each other, placed in a straight oblique line parallel with frontal suture, anterior ocellus just behind ventrolateral part of antennal rings. Mandible without any elevation or tooth between retinaculum and apex. Prothoracic shield transversally aciculate Meso- and meta-thoracic dorsal plates hardly developed. Basal plate of cerci subtriangular laterally with somewhat convex margin; slightly longer than frons, surface smooth. Cerci smooth, slender, about as long as basal plate; distal half divergent, hook-shaped with apex moderately recurved, proximal half fused, stalk-like, medianly and dorsally with an unpaired small protuberance.

CYMATODERA INORNATA Say.

Hopk. U. S. No. 9791*v*; mature. Species reared; larval skin and imago preserved.

(Fig. 96.)

Very close to *C. bicolor* in size and all structural details; differs from this species only in the following characters: Posterior part of frons and dorsal side of epicranium transversally rugulose, basal plate of cerci transversally rugulose, no unpaired median protuberance present dorsally on stalk-like proximal half of cerci, color of membranous parts is dorsally purple with whitish pattern.

DIVISION IV (pp. 617–619).

Ocellus one or none.

11. Genus ORTHOPLEURA Spinola.

Body tumid claviform with comparatively small thoracic segments and fourth to sixth abdominal segments large; ninth abdominal segment small and short, anteriorly comparatively wide, subconical; abdomen dorsally without ampullae, ventrally rounded. Chitinous parts poorly developed. Membranous parts whitish. Setae thin, short, and scarce. Headcapsule small, subtriangular with strongly curved sides. Frons without sculpture. Epicranium without sculpture; anterior margin of hypostoma slightly emarginate. Ocellus absent, possibly represented by a slightly protuberant, rather large, round, colorless spot just behind the ventrolateral part of antennal ring. Length of basal, second, and apical antennal joints proportioned as $1\frac{1}{2}:1:1$; supplementary joint small. Mandible about one-third the length of frontal suture, a trifle longer than wide, pointed; retinaculum well developed, situated slightly above middle of inner margin; tooth present between retinaculum and apex. Maxilla with low, band-like chitinization at the base of cardo and stipes; length of basal, second and apical joints of maxillary palpus proportioned as $1:1:1\frac{1}{2}$; palpiger well developed with small chitinization. Gula not chitinized, laterally poorly defined, slightly shorter than frons, not much longer than maxilla. Submentum and mentum not chitinized. Stipes labii thinly chitinized; length of basal and apical joints of labial palpus proportioned about as $1:1$. Prothorax subconical, about as wide as long, somewhat longer and narrower than the following thoracic segments; no prothoracic shield; no sternal plate. Meso- and meta-thorax without dorsal chitinization; hypopleural support for legs chitinous. Legs short, poorly chitinized. Abdomen with normally developed intersegmental membranes; abdominal segments smooth, without ampullae, swollen to the extent that the different areas can not be defined. No basal plates of cerci. Cerci well separated, very small, hook-shaped.

This genus is in many respects closely related to genera as *Neichnea* and *Phyllobaenus.*

ORTHOPLEURA DAMICORNIS Fabricius.

Hopk. U. S. No. 10369*d;* mature. Species reared; cast skin and imago preserved.

(Figs. 12, 26, 39, 59, 77, 99, 108, 131.)

Total length of body, 10mm.; extreme width about 2½ mm.; extreme thickness, 2¼ mm.; anterior width of prothorax, about 1 mm. Mandible, epistoma, endocarina of frons, tarsi, and cerci pale brown; remainder of headcapsule, antennal, maxillary, labial chitinizations and legs pale clay yellowish; membranous parts of body whitish. Setae whitish. Mandible with sharp retinaculum; tooth between retinaculum and apex about as large and sharp as retinaculum; two thin mandibular setae. Cerci, without consideration of the recurved part, one-ninth the length of frons.

12. Genus MONOPHYLLA Spinola.

Body vermiform with short thoracic segments and prolonged abdominal segments; long intersegmental membranes; ninth abdominal segment rather small, subcrescentiform; no dorsal ampullae, laterally with protuberant lobes, ventrally rounded. Chitinous parts moderately developed. Membranous parts whitish. Setae thin; numerous on chitinous, scarce on membranous parts. Head capsule small, subtriangular with curved sides. Frons sculptured; in one species with an unpaired median protuberance. Epicranium rather smooth with well-marked pits for the setae; anterior margin of hypostoma slightly concave. Ocellus moderately developed, situated just behind ventrolateral part of antennal ring. Length of basal, second, and apical antennal joints as 3:1:2; supplementary joint small. Mandible about half as long as frontal suture, a trifle longer than wide, rather stump; retinaculum well developed, situated just above the middle of the inner margin; tooth present above retinaculum (fig. 27). Maxilla with low, bandlike chitinization at the base of cardo and stipes. Length of basal, second and apical joints of maxillary palpus proportioned as 2:1:2; palpiger with chitinous plate. Gula as long as frons; nearly twice as long as the maxilla. Submentum and mentum poorly chitinized. Stipes labii moderately chitinized; length of basal and apical joints of labial palpus proportioned about as 1:2. Prothorax transversely subrectangular, about three times as wide as long, hardly as wide but longer than the following thoracic segment; prothoracic shield poorly developed; sternal plate large, rectangular, longer than wide, thinly chitinized. Meso- and metathorax without dorsal chitinizations; hypopleural chitinized support for the legs present, but not strong. Legs short, moderately chitinized. Abdomen with intersegmental membranes

about one-third the size of the segments; dorsal ampullae not developed, alar area protuberant, postscutellum large, epipleural lobe protuberant. Dorsal side of ninth segment thinly chitinized, but a definite basal plate is not developed. Cerci well separated, of medium size, hookshaped.

The present genus is in many respects closely related to *Neiohnea* and *Phyllobaenus*, as well as to *Tarsostenus*.

MONOPHYLLA TERMINATA Say.

Hopk. U. S. No. 12228*b*; mature. Species reared; cast skin and imago preserved.

(Figs. 13, 27, 40, 60, 75, 97, 109.)

Total length of body, 16 mm.; extreme width, about 2 mm.; extreme thickness, 2 mm.; anterior width of prothorax, 1½ mm. Mandible, epistoma, mediocarina of frons, and tarsi Roman sepia; remainder of head capsule, trophi, antenna, dorsal chitinization of prothorax, legs, hypopleural chitinization and cerci brown ocher; membranous parts whitish. Setae cream white. Frons with transversal impression behind clypeus; a deepening behind angulus frontalis, and in the center a round conical protuberance with a small pit in the top. Mandible with sharp retinaculum; tooth between retinaculum and apex about as large and sharp as retinaculum; one mandibular seta. Cerci, without consideration of the recurved part, about half as long as frons.

MONOPHYLLA CALIFORNICUS Fall (M. PALLIPES Schaeffer).

Hopk. U. S. No. 12654*b*; mature. Species reared; cast skin and imago preserved.

In every respect identical with *M. terminata* except in the sculpture of frons, where the central round, conical protuberance with the small pit in the top is lacking.

Subfamily C (pp. 619-620).

Frons posteriorily limited by an obtuse angle. Epicranial halves dorsally adjacent to a posterior free prolongation of the endocarina of frons; a distinct unpaired epicranial suture thus not present. Second antennal joint large, three times longer than apical antennal joint. Gula with flat surface. Abdominal preeusternal and eusternal areas not distinctly separated. Spiracles all annuliform. Ocelli, one on each side.

13. Genus PRIOCERA Kirby.

Body robust, digitiform with median abdominal segments only slightly larger than the other segments; ninth abdominal segment rather large, oblong, conical; abdomen with ampullae. Chitinous parts moderately developed. Membranous parts whitish. Head capsule well sized, subglobose, with ventral side predominant. Frons

conspicuously sculptured with unpaired median protuberance. Epicranium dorsally and posteriorly obliquely wrinkled, otherwise smooth; anterior margin of hypostoma concave. Ocellus small, close behind ventrolateral margin of antennal ring. Basal, second, and apical antennal joints proportioned as 1½ : 3 : 1; supplementary joint small; basal connecting membrane elongate, cylindrical. Mandible plump, as long as wide, length about three-fourths of frontal suture; apex blunt, not projecting over inner corner of mandibular base; retinaculum hardly developed; one tiny, rounded tooth present below apex; two very short and fine mandibular setae. Maxilla with cardo and stipes basally covered by a comparatively large chitinization; length of basal, second and apical joints of maxillary palpus proportioned as 2 : 1 : 1; palpiger jointlike, chitinized. Gula poorly chitinized, as long as frons and as long as maxilla. Submentum and mentum poorly chitinized. Stipes labii chitinized; length of basal and apical joints of labial palpus proportioned about as 1:1. Prothorax anteriorly about as wide as head, posteriorly somewhat wider, about two-thirds as long as wide, somewhat longer and narrower than the following thoracic segments; dorsally chitinized, no distinctly defined thoracic shield; no distinct sternal plate. Meso- and metathorax slightly or not chitinized dorsally. Legs poorly chitinized, rather short. Abdomen with well-developed ampullae on second to seventh abdominal segments; lateral areas swollen. No definite basal plate of cerci; the whole dorsal surface of ninth segment slightly chitinized, posteriorly with grainlike asperites. Cerci short, straight proximally fused, distally divergent, apically bifid. Mesothoracic spiracles twice as large as the abdominal ones.

The systematic position of the present genus is isolated.

PRIOCERA CASTANEA Newman.

U. S. Nat. Mus., Wash., D. C.; Specimen labeled "*Priocera castanea* in white oak log with Lymexylon, Va., shore opp. Plummer's Island, Md., July 25, 1909; adults bred last year and also collected on same log this year." H. S. Barber, Colr.

(Figs. 14, 28, 41, 61, 76, 98, 110.)

Total length, 13 mm.; extreme width, 2¼ mm.; extreme thickness, 2¼ mm.; anterior width of prothorax, 2 mm. Mandibles, epistoma, endocarina of frons, end of cerci Roman sepia; remainder of head capsule and trophi, antennae, prothoracic shield, and tarsi from brown ocher to pale cadmium yellow; membranous parts whitish. Setae fine, short, and whitish; numerous on chitinized, sparse on membranous parts. Two mandibular setae.

Subfamily D (pp. 620–622).

Frons posteriorly limited by an acute angle. Epicranial suture present, short. Second antennal joint small, about as long as apical

antennal joint. Gula with unpaired, large chitinous tubercle. Abdominal preeusternal and eusternal areas not distinctly separated. Spiracles very small, all bifore. Ocelli, five on each side.

14. Genus THANEROCLERUS Lefebvre.

Body elongate, digitiform; ninth abdominal segment well developed, semiglobose. Chitinous parts well developed. Membranous parts unicolorous, with vivid color. Setae thin, rather numerous, scattered. Head capsule subrectangular, longer than wide, dorsally convex. Frons without distinct sculpture. Epicranium dorsally without sculpture; ventrally, posterior to the gular tubercle with deep, transverse, curved wrinkles; anterior margin of hypostoma straight transversal. Ocelli five; three in an anterior, upwards and backwards oblique row behind lateral part of antennal ring, two in a posterior row parallel with the anterior one; the lower posterior ocellus on the level with the upper anterior ocellus. Length of basal, second, and apical antennal joints proportioned as $1\frac{1}{2}:1:1$; supplementary joint small. Mandible about half as long as frontal suture; length to width about as $3:2$, pointed, apex right above inner corner of mandibular base, retinaculum small, at the middle of inner margin of mandible; tooth above retinaculum low, rather obtuse. Maxilla with a band-like chitinization at the base of cardo and a comparatively large rectangular chitinization on stipes; length of basal, second, and apical joints of maxillary palpus proportioned about as $1:2:2$; palpiger well developed with joint-like chitinization. Gula well chitinized, as long as frons, about three times as long as maxilla; unpaired tubercle large, placed centrally. Submentum and mentum somewhat chitinized. Stipes labii chitinized; length of basal and apical joints of labial palp proportioned as $1:1$. Prothorax subrectangular, half as long as wide; twice as long and somewhat narrower than the following thoracic segment, dorsal shield well chitinized; sternal plate narrow, lanceolate. Meso- and meta-thorax with conspicuous dorsal chitinizations. Hypopleural chitinization for the support of the leg well developed. Legs of moderate size, well chitinized. Abdomen with normally developed intersegmental membranes; ampullae slightly indicated. Basal plate of cerci circular, flat, well chitinized, covers median half of the dorsal surface of ninth abdominal segment. Cerci rudimentary in mature forms, reduced to two granuliform elevations; in the previous stages comparatively larger and more lobeshaped.

The systematic position of this genus is very isolated.

THANEROCLERUS GIRODI Chevrolat.

Hunter U. S. No. 3459; mature. Species reared, imago preserved.

(Figs. 15, 29, 42, 62, 78, 100, 101, 113, 126.)

Total length of body, 9 mm.; extreme width, about 2 mm.; extreme thickness, $1\frac{3}{4}$ mm.; anterior width of prothorax, $1\frac{1}{4}$ mm. Head

capsule with length to width as 5:4. Chitinous parts shiny. Head capsule Indian red; mandibles dark brown; prothoracic shield brown ocher, posteriorly with two sepia brown spots; Meso- and metathoracic plate, basal plate of cerci sepia brown; remainder of chitinized parts brown ocher to pale brown; membranous parts vermilion red. Setae pale yellow. Mandible with two setae. Spiracles very small, the mesothoracic spiracles somewhat larger than the abdominal ones; peritrema and finger-shaped tubes slightly chitinized.

Subfamily E (pp. 622–624).

Frons posteriorly limited by a transversal line. Epicranial suture not developed. Second antennal joint small, considerably shorter than both basal and apical antennal joints. Ventral mouthparts slightly retracted. Gula with plain surface. Preeusternal and Eusternal areas not separated. Spiracles bifore. Ocelli, five on each side.

15. Genus HYDNOCERA Newman.

Body short, digitiform or oval, somewhat flattened; ninth abdominal segment semioval or semicircular. Chitinous parts well developed. Membranous parts unicolorous or variegated. Setae numerous, scattered. Head capsule trapezoidal, posteriorly wider than anteriorly; somewhat wider than long. Frons smooth. Epicranium smooth. Ocelli five, anterior row bent slightly forwards. Length of basal, second and apical antennal joints proportioned as 3:1:3; supplementary joint twice as long as second joint. Mandible about half as long as frontal suture, length to width about as 6:5; pointed; apex somewhat retracted behind inner corner of mandibular base; posterior half of inner margin convex; retinaculum hardly developed; tooth behind apex low and blunt; with a single mandibular seta. Length of maxilla from end of palpus to posterior corner of cardo in proportion to gula about as 1:2; posterior parts of cardo and stipes without special chitinizations; maxillary palpus with small apical joint; length of basal, second and apical joints of maxillary palpus proportioned as 3:5:1; palpiger with plate-shaped chitinization. Gula about same length as frontal suture. Basal and apical joints of labial palpus proportioned about as 1:3. Prothoracic tergal shield well developed, along middle line about as long as frontal suture; prothoracic sternal plate large, subtriangular, anteriorly fused with the presternal chitinizations; posteriorly pointed. Legs well developed. Abdomen with normally developed intersegmental membranes; dorsal ampullae absent, but substituted by very small dorsal plates. Ninth abdominal segment dorsally slightly chitinized. Cerci absent. Spiracles small; the two spiracular tubes short and about circular.

1. HYDNOCERA SCABRA LeConte.

U. S. Nat. Mus., Wash., D. C.; labl. D. W. Coquilett 4981. Not reared.

Total length, 5 mm. Color of head capsule pale yellow, the same color throughout; prothoracic dorsal shield brown ocher, prothoracic sternal plate light brown ocher; legs pale yellow; basal plate on ninth abdominal segment pale yellow. Membranous parts motley bluish with whitish pattern above heart and muscle attachments, all abdominal segments colored alike. Setae thin and light yellowish. Ninth abdominal segment with semioval, nearly semicircular basal plate. Cerci not present.

HYDNOCERA VERTICALIS Say.

(Hopk. U. S. No. 10084*c*; mature. Species reared, cast skin and imago preserved. Description after cast skin.)

(Figs. 16, 30, 43, 63, 102, 118, 120, 132.)

Total length, about 2½ mm. Head capsule pale yellow with ocellar field and posterior third of frons black brown, ventral hind margin of epicranium and hind margin of gular plate with small black brown darkening; prothoracic dorsal shield pale yellow with two large black brown spots on each side, adjacent to the middle line; prothoracic sternal plate and presternal chitinizations pale brown; leg pale yellow with black brown coxa and a black brown spot at the distal end of femur, tarsus pale brown; abdominal segment with small dorsal plates; surface of epipleural lobes somewhat chitinized; basal plate of ninth abdominal segment pale yellow, posteriorly gradually darkening. Membranous parts light. Setae long, stiff, dark brown. Ninth abdominal segment with semioval basal plate.

HYDNOCERA PUBESCENS LeConte (?).

Hunter U. S. No. 3062*V*, l. *b*; possibly not mature. Species not reared.[1]

Total length, 2½ mm. Head capsule pale yellow with hind margin of frons and dorsal hind margin of epicranium dark brown; prothoracic dorsal shield brown ocher, on each side with three more or less confluent dark brown spots; the anterior spot laterally at the front corner of the shield, the posterior and smallest spot at the back corner close to the middle line, and the median and largest spot at the beginning of the hind margin right between the anterior and posterior spots; prothoracic sternal plate dark brown; leg pale yellow with dark brown coxa; basal plate of ninth abdominal segment dark brown, gradually changing into a median lighter field. Membranous parts of meso- and metathorax variegated, blackish blue with whitish pattern; first abdominal segment blackish blue with whitish muscle attachments, second and third abdominal segment nearly entirely

[1] Determination kindly given by Dr. W. D. Pierce. Compare bibliography.

whitish; fourth, fifth, sixth segments nearly entirely blackish blue, seventh whitish. Setae long, stiff, light brownish. Basal plate nearly semicircular.[1]

PART II.

NOTES ON THE SEASONAL HISTORY AND BIOLOGY OF NORTH AMERICAN CLERIDAE.

The Cleridae are among the principal predators of wood and bark boring beetles. They are predaceous in both larval and adult stages, the adults attacking the adults of the destructive species while the larvae feed upon the eggs and broods in the bark and wood.

Under natural conditions they may be of but nominal importance but can be turned to considerable account in control measures with the additional help of man, who can overbalance the natural conditions in favor of the predators by properly conducted control work.

To benefit by their predaceous habits it becomes necessary to learn as much as possible concerning their general habits and seasonal history.

With this knowledge gained, control work can be conducted at times best suited to the preservation of the predators or at least by taking measures for their protection while destroying the host. This would greatly facilitate the control on barkbeetles as recommended by Hopkins[2], which includes the percentage principle of control, namely the disposal of 50 to 75 per cent of the tree-killing beetles.

Whenever practicable the dissemination of Cleridae in quantities in badly infested regions in addition to control measures would evidently be of great value. Especially in the case of the genera *Thanasimus* and *Enoclerus* among which are to be found the most important economic species.

The adults of most of the species of Cleridae are very active, and when disturbed take flight readily or drop and crawl into the debris upon the ground.

Some of them are active at night, others in the daylight. Most of them prefer bright sunny days when they may be observed running over infested trees or on flowers. The nocturnal species may be observed by the aid of a small searchlight upon infested trees. They are attracted to artificial light and may be captured with trap lanterns. The nocturnal species do not frequent flowers.

Adult Clerids consume numbers of Scolytoidea and other small insects. Sometimes they will attack insects much larger than themselves. In the usual method of attack the Clerid remains motionless until a wandering Scolytoid or some other insect approaches close

[1] According to Bulletin 100, Bureau of Entomology, Department of Agriculture, 1912, page 68, a single specimen of the species *Hydnocera pallipennis* Say was reared April 6, 1907, but the larval skin was not saved. No larva determined as belonging to this species is present in the special collections of the Bureau of Entomology nor in the general collections of the United States National Museum in Washington, District of Columbia.

[2] Bulletin 83, pt. 1. Bur. Entom., U. S. Dept. Agri. 1909.

enough. Then running with a rapidity that resembles a leap, it seizes the prey. Grasping it with the front and middle pair of legs and holding on to the bark by the hind pair, sometimes balanced by the tip of the abdomen against the bark, it proceeds to feed. With its strong jaws it breaks the chitin or separates the segments and feeds upon the soft tissue and viscera within.

In several genera there are instances where the adults are apparently not predaceous, but are to be found on flowers, where they feed upon the pollen.

During their activities mating occurs, on flowers, on infested trees, or trees being attacked by barkbeetles. It is more difficult to find them ovipositing. The eggs are usually placed in or near the entrance gallery of their host.

Certain species of Clerid larvae in all stages are found in the galleries and mines of bark and wood borers. They prey upon the eggs, larvae, and sometimes the dead (?) parent adults of the host. They feed voraciously and grow rapidly. As mature larvae they pass a considerable time often without taking much food. During this stage they construct the pupal cell in which considerable time is spent previous to pupation. The pupal cell may be made in the earth, the bark, or in the cell of the host. Many species line their cells with an exudation of a white silvery color. Others use it to seal the ends of borer cells which they reconstruct to suit their purposes. Others make a complete cocoon, utilizing the exudation or cement to hold the particles of earth together and to form a smoother interior on which to lie as pupae.

Clerids overwinter, sometimes in all stages, sometimes in a certain stage. The time of transformation to adults is generally in the spring but it varies. Some of the species may have more than one generation in a season, especially if there are several generations of the host. Others appear to pass several years in the larval stage.

The following notes are from the records on file in the office of the forest entomologist, United States National Museum, made by members of the Branch of Forest Entomology, of the Bureau of Entomology, United States Department of Agriculture, and from special notes and observations by the author.

Genus MONOPHYLLA Spinola.

MONOPHYLLA CALIFORNICA Fall (=M. PALLIPES Schaeffer).

Is a predator on Bostrychidae and small secondary woodborers in *Acacia greggii* and *Prosopis juliflora* from Arizona. Collected by M. Chrisman and reared at Eastern Station, Forest Insect Branch. *Schizax senex* reared from same wood.

MONOPHYLLA TERMINATA Say.

Is a predator on borers in dead decidous trees and seasoned wood. The adults are to a great extent nocturnal in habits, hiding during the daytime in crevices and beneath the bark.

There is a great variety of hosts, but it appears to be most plentiful in dry wood attacked by *Sinoxylon.*

It has been reared from *Celastrus scandens* infested by small Cerambycidae; wild grape infested by *Phymatodes amoenus; Diospyros virginiana* infested by *Sinoxylon;* hickory infested by *Sinoxylon, Lyctus* and other borers; sassafras with *Ptinid;* ashboard infested by *Lyctus;* Celtis infested with *Scolytus muticus;* also oak, honey locust, mesquite, and probably most any hardwood.

The adults fly May and June.

The species occurs throughout the Eastern, Central, South, and Southwestern United States.

Observations by Hopkins, Fiske, Van Horn, Kirk, Chrisman, Champlain.

Genus CYMATODERA Gray.

The adults of this genus are to a great extent nocturnal. They are attracted by strong light, may be found at arc lights or taken in trap lanterns.

The seasonal histories of the different species studied are very similar. The larvae are predators on the larvae of secondary woodborers, principally Cerambycidae and Buprestidae. They tunnel through the sawdust-packed mines of the woodborers, feeding on the woodboring larvae or pupae and finally utilizing their mines or cells as pupal cells of their own.

They do not line their cells as heavily as do the *Enoclerus* but all soft particles are held together with interior smooth and ends sealed with the exudation that is common to them for this purpose.

CYMATODERA BRUNNEA Melsh.

Adults active during July in Pennsylvania. Champlain.

CYMATODERA BICOLOR Say.

Is a predator in the larval stage on the larvae and pupae of secondary woodborers. It overwinters in the larval and pupal stages. Adults active during May, June, July; habits retiring, nocturnal; are attracted to lights; mate and oviposit at night.

Larvae are found in the galleries or mines of host. At Lyme, Connecticut, they occur in dead dry dogwood (*Cornus florida*) and *Benzoin benzoin,* in the larval mines, and pupal cells of *Crytophorus verrucosus* and other borers.

They may be traced and located by following their small, unpacked mines, which are tunneled through the sawdust-packed galleries of their host.

In most instances the pupal cell of the host was utilized, but in some cases they constructed pupal cells in the galleries or in the wood. Pupae were found from December 1st until spring. The majority overwinter in the pupal stage rather than that of mature larvae, as do most of the Clerids studied. The pupal cell was but slightly lined with the whitish exudation, but the loose particles and frass at each end of the cell were firmly sealed with it.

In most cases the pupae rested vertically in the cell.

The transformation from pupal to adult stage takes place in early spring. The adults begin to emerge in June.

The species occurs in Eastern and Central States, Southwest to Texas. Observations by Champlain.

Adults collected by Fiske beneath chips and dead bark of girdled chestnut, Melrose, North Carolina, May 18, 1903; by Hopkins, Wood County, West Virginia, May 15, 1891.

CYMATODERA INORNATA Say.

Is a predator on secondary woodborers. Reared from dead, dry limbs of hickory infested by *Bostrychus bicornus;* from dead standing birch infested by *Melasis* and *Buprestid* larvae; also reared from oak, hackberry, and beech.

Adults fly during June and July in Pennsylvania.

Occurs in Eastern and Central United States.

Observations by Hopkins, Craighead, Van Horn, Champlain.

CYMATODERA MOROSA LeConte.

Is a predator in larval stage on *Cerambycid* and *Buprestid* borers infesting scrub oak in Colorado. Found feeding on *Chrysobothris* larvae beneath bark and larvae of *Brothylus geminatus* in the base and roots. The life history as far as noted is very similar to *C. bicolor*, except that pupae were not observed until spring. Observations by Champlain, at elevations ranging from 6,000 to 7,000 feet in Colorado.

CYMATODERA UNDULATA Say.

Is a predator on wood; stem and twig borers. Reared from chestnut infested by *Callidium aereum;* maple infested by *Euonemids; Populus deltoides* infested by *Oberea;* oak infested by *Elaphidion;* also from sumac, wild grape, hackberry, birch, butternut, *Celastrus scandens* and *Ampelopsis quinquefolia.*

Adults fly during July, August, and September. Occurs in Eastern and Central United States. Observations by Hopkins, Kirk, Fiske, Craighead, Webb, Van Horn.

CYMATODERA BALTEATA LeConte.

Adults reared from dying wild grape infested by *Clytoleptus albofasciatus* in Pennsylvania; also reared from hickory and hack-

berry infested by secondary borers. Observations by Kirk and Champlain. Reared from dead *Morus rubra* infested by *Cerambycidae*, J. N. Knull.

CYMATODERA OVIPENNIS LeConte.

Is a predator on Lepidopterous larvae infesting cones of *Pinus jeffreyi;* reared from cones of Pinus ponderosa and *Pseudotsuga taxifolia;* from Piñon pine infested with secondary *Pityophthorus* and from big cone spruce infested with *Carphoborus* and *Callidium*.

Obeservations by A. D. Hopkins in Ventura County, California, and by J. M. Miller at Ashland, Oregon.

Genus PRIOCERA Kirby.

PRIOCERA CASTANEA Newman.

Is apparently a predator on barkbeetles and borers in coniferous trees. Larvae taken at Damascus, Virginia, from moist sapwood of pitch pine killed by *Dendroctonus frontalis* by T. E. Snyder. From pine at Tryon, North Carolina, by W. F. Fiske. Adult on bark of pine attacked by *Dendroctonus valens* at Flagstaff, Arizona, by J. L. Webb. Adults taken at night near Harrisburg, Pennsylvania, by H. B. Kirk. Adult flies during June. On dead hickory at night, Pennsylvania, J. N. Knull.

Genus TARSOSTENUS Spinola.

TARSOSTENUS UNIVITTATUS Rossi.

Is principally a predator on powder post beetles as *Lyctus* and *Sinoxylon* in dry, seasoned wood products.

Reared from ash timber infested with *Lyctus parallelocollis*, received from Portsmouth Navy Yard; from hickory lumber infested with *Lyctus;* persimmon blocks containing work of *Lyctus* and *Sinoxylon;* white oak infested with *Lyctus;* from hickory axe handles containing *Lyctus*, and other similar articles. Observations by T. E. Snyder.

Genus THANASIMUS Latreille.

THANASIMUS TRIFASCIATUS Say.

Note by W. F. Fiske, made October 19, at Grand Lake, Michigan. "Clerid adults and larvae in cells at base of *Picea* killed by *Dendroctonus*. Clerid larvae were extremely common at base of tree. They seemed to migrate there. From the location of some, it seems as though they went into their pupal cells from the outside." Pennsylvania, reared from white pine. J. N. Knull.

THANASIMUS DUBIUS Fabricius.

Is a predator on barkbeetles, *Ips*, *Dendroctonus*, *Polygraphus*, etc., Pissodes and other borers in coniferous trees, mostly pine and spruce.

An article by Dr. A. D. Hopkins that appeared in the West Virginia Agriculture Experiment Station, Bulletin No. 56, published April, 1899, gives a good account of this species, as follows:

The American barkbeetle destroyer is often quite common on the bark of spruce trees infested with barkbeetles. It passes the winter in all stages from larva to adult in the bark in which it is bred, the latter sometimes in the loose bark and moss at the base of the tree. The adults appear in the spring, soon after the barkbeetles commence to emerge from their winter quarters and fly to the trees, logs, or tops, which are infested with barkbeetles. There they station themselves beneath loose flakes of bark, awaiting an opportunity to pounce upon any barkbeetle that comes near. They also move rapidly about over the bark in search of the prey, or the entrances to the barkbeetle galleries in which the females deposit their eggs. The eggs soon hatch into minute-active worms, which find their way into the egg and brood galleries of the barkbeetles where they feast upon the eggs and young found there until they have attained their full growth, when they leave the inner bark and excavite cavities in the outer corky bark in which they change to pupae and adults.

This clerid attacks and feeds upon all kinds of barkbeetles which infest spruce and pine and has been found attacking barkbeetles in deciduous trees. It is widely distributed over the State (West Virginia) and doubtless has a wide range throughout North America.

It is a common insect wherever the pines and spruces grow in the State, and doubtless exerts a considerable influence in preventing the undue increase and devastations of pine and spruce barkbeetles.

Distribution, eastern United States southwest to Texas.

THANASIMUS UNDULATUS Say, and variety NUBILIS Klug.

Is a predator on Dendroctonus and other barkbeetles in coniferous trees, *Pinus*, *Picea*, *Pseudotsuga*, *Larix*, *Abies*, and *Cedar*, and occurs wherever these trees are found.

Habits very similar to *T. dubius*. Observed at elevations ranging to 10,000 feet. Adults fly May to September.

Observations by Hopkins, Burke, Fiske, Champlain.

THANASIMUS NIGRIVENTRIS (Le Conte) (=ENOCLERUS NIGRIVENTRIS LeConte).

Is a predator on barkbeetles on coniferous trees.

Adults are active during sunny days from April to October, running over newly cut trees and branches. They feed upon the small Scolytoids that attack these trees, such as *Ips*, *Pityophthorus*, etc., and *Dendroctonus* in larger trees.

Mr. J. L. Webb describes the feeding of this species in his notes, as follows:

Elmore, S. Dak., Aug. 23, 1902.—Pine. Clerid discovered on bark of experiment tree, preying on *Dendroctonus ponderosa*. *Dendroctonus* not dead. Jaws of Clerid inserted between prothorax and mesothorax. When dropped into a dry vial, Clerid, after running about a little while, still holding the *Dendroctonus*, braced itself against the cork of the bottle, bottle being held horizontally. With the two hind feet holding on to the cork and the posterior end of the body against the cork, the Clerid proceeded to make its meal.

During the first part the prothorax of the Clerid rested on the lower side of the bottle, body of the Clerid upside down. Later the front of the body was lifted clear of the floor and the meal was finished in midair.

The two front pairs of legs were used to grasp and turn the victim, much as a squirrel holds a nut while eating it. The Clerid ate ravenously of the interior of the prothorax, inserting the jaws between the head and thorax. Finally, the head and thorax being severed from the abdomen, the Clerid finished up on this.

They mate and oviposit at this time. The eggs are deposited in the entrance galleries of host. The larvae upon hatching crawl through the galleries and mines, feeding upon the barkbeetle broods.

According to W. S. Fiske (in notes) the pupal cells are made in the bark of the tree. Adults ready to emerge observed Apr. 23.

Distribution: Western and Middle Western United States; also recorded from Michigan and Wisconsin.

Observations by Hopkins, Webb, Fiske, Edmonston, Burke, Champlain.

Genus PLACOPTERUS Wolcott.

PLACOPTERUS THORACICUS Olivier.

Is a predator on the smaller barkbeetles and borers in twigs and limbs of deciduous trees. W. F. Fiske states in his notes: "This species was very common in the jarring for *Curculio* in Georgia in 1901. And without question is an enemy of *Scolytus rugulosus*."

The adults may be taken during the summer months upon the foliage of trees and sometimes on flowers.

Early larval stage not noted. At Lyme, Connecticut, it overwinters in the abandoned pupal cells of *Magdalis olyra* in hickory and probably prey upon the *Magdalis* broods. Also found overwintering in the galleries of *Oncideres* in hickory twigs, infested with *Chramesus icoriae*, and in butternut twigs infested with small *Cerambycid* larvae.

The larvae were all prepupal in their cocoon-like cells, lined with the frothy exudation and attached to the wood.

Observations by Hopkins, Fiske, Champlain. Pennsylvania, Kirk, Knull.

Genus ENOCLERUS Gahan.

Some of the species of this genus are the most important predators on barkbettles and might be utilized to considerable advantage in control measures.

The general habits of the different species vary considerably. One species is active at night, others in daylight. Some are to be found on flowers, where they feed to some extent on pollen; others are never found on flowers.

All of the species studied line their pupal cells heavily with an exudation that is foam-like in substance, of a silvery luster, making a smooth interior, attaching exterior to the bark or if cells are in

the earth, holds together the loose particles and forms a sort of cocoon.

They are all active and strong fliers and are predaceous in both adult and larval stages.

ENOCLERUS HUMERALIS Schaeffer.

Adults emerged from infested cones of *Pseudotsuga taxifolia*, Waldo, Oregon, August 16, 1914, P. D. Sergent, predaceous Clerid feeding on the insects which are issuing from cones of *P. taxifolia*. Quincy, California, September 21, 1916. Observations by F. P. Keen.

ENOCLERUS QUADRIGUTTATUS Olivier.

Is a predator on the larvae and adults of *Scolytoids* and *Pissodes* in coniferous trees, pine, spruce, juniper, etc., and on *Scolytoids*, *Curculionids* and small borers in hardwood trees, butternut, ash, mulberry, wild cherry, etc.

Adults are diurnal and may be observed running over infested trees throughout the summer months. Adults have been found during the winter months beneath bark and debris and it is very probable that this is the general method of overwintering.

All records show that this is a common species and one that could be utilized in control.

W. F. Fiske notes the feeding of this species on the larvae of *Pissodes strobi* in white pine terminals. "Three Clerid larvae were found with the *Pissodes* in terminals examined. One of the larger ones was found in the cells of a Pissodes which was partly devoured and its tracks could be traced backward through four and possibly six empty cells."

Dr. A. D. Hopkins records pupae and adults in white lined pupa cases in outer bark at base of White Pine stump infested by *Hylurgops*. August 27. Also larvae and pupae in cocoons in outer loose bark of red cedar, August 6.

The species is distributed throughout the eastern part of the United States to the Mississippi and in the southwest.

ENOCLERUS ROSMARUS Say.

Adults are found on flowers during summer months. Falls Church, Virginia, H. B. Kirk, Sumac. Reared at eastern station. Pennsylvania, Kirk, Knull, Champlain.

ENOCLERUS EXIMIUS Mannerheim.

Clerid adult on live oak limb September 17. Chiricahua Mountains, Arizona. J. L. Webb.

ENOCLERUS MUTTKOWSKII Wolcott.

Clerid larva under bark of *Tsuga canadensis*. Bemis, West Virginia. Collected by H. G. Champion. Reared at eastern station.

ENOCLERUS SPINOLAE LeConte.

Clerid common, larvae in pupae cases in outer bark of Yucca. Hesperia, California, May 12. Observations by Dr. A. D. Hopkins.

ENOCLERUS MOESTUS Klug.

Adults active during daytime, July, August. Observed on various conifers (in Colorado) and is probably a predator on barkbeetles and other borers. Especially common on small pinon pine infested with barkbeetles and small Cerambycid larvae. Seems to range slightly higher in altitude than does *E. sphegeus* in Colorado.

Collected on tanglefoot screen. August. Altitude 7,500 feet. Observations by Edmonston, Hofer, Champlain.

ENOCLERUS SPHEGEUS Fabricius.

Is an important predator on *Dendroctonus* and other barkbeetles in the Western States. My studies were made in Colorado, where it is predaceous on barkbeetles in various conifers at elevations ranging from 6,000 to 8,000 feet.

It is an important enemy of *Dendroctonus ponderosae* Hopkins and its history in connection with this species is as follows:

Adults.—The adults appear in June and are at once attracted to infested trees. These trees would contain overwintered broods in the case of *D. ponderosae.* On sunny days the adults may be observed running about mating or feeding. They may remain motionless for a considerable time while waiting for their prey, but drop or fly when disturbed. Their food consists of any small insects that are attracted to the infested trees, principally barkbeetles. They are able to handle objects three times their own size, but prefer smaller objects. The adults continue to live during the warm summer months, sometimes four or five months.

Eggs.—The eggs are deposited soon after the adult emerge, latter part of May or June. The eggs are placed in trees that contain *Dendroctonus* (*D. ponderosae*) broods and must hatch soon after being laid, as the larvae must feed and make their growth before the *Dendroctonus* beetles emerge.

Larvae.—The larvae, being voracious feeders, grow rapidly, and during this time they consume many *Dendroctonus* larvae and pupae.

About the 1st of August the *Dendroctonus* broods consist mostly of adults ready to emerge. Now we find the almost full-grown *Clerus* larvae wandering about among the galleries and beneath the bark.

Upon the emergence of the *Dendroctonus* broods, the Clerid larvae being full grown, go into the ground at the base of the same tree for hibernation. This migration occurs at night. They enter the ground and burrow for several inches in depth close to the

base of the tree and begin to construct their pupal cells. They overwinter in these cells in the larval stage.

The cells are made in the dirt and debris, in bark crevices, or any suitable place. The cell is lined with the exudation, foam-like and of a silvery luster. This tends to hold all loose particles together, especially when the cell is made in the soil, and provides a smooth surface for the larva and pupa to rest upon as well as a protective covering.

No larvae were found in trees containing the overwintering *Dendroctonus* broods.

Pupae.—Exact duration of pupal stage not learned, but probably short. After transformation the adults may remain for a time in their cells and emerge in May, appearing in numbers in June.

The control of *D. ponderosae* in Colorado should be attempted between September and April, inclusive, of the following year in order to prevent the destruction of these predators which are then in their cells at the base of trees from which the *Dendroctonus* broods have already emerged.

During May, June, July, and August the Clerid larvae are in the trees feeding upon the *Dendroctonus* broods. The larvae of *E. sphegeus* were seldom found among the *D. ponderosae* broods during the winter months.

Observations by Champlain, assisted by W. D. Edmonston and George Hofer.

There are more records of *E. sphegeus* on file in the office of the forest entomologist than any other species. It is very common and easily handled, and should prove of great benefit as a predator on *Dendroctonus* and other barkbeetles in coniferous trees during control operations.

Its seasonal history in connection with the species to be controlled would be the first item; then proper measures for the safety of the predator could be made while destroying the host.

It is found in most of the western pines, spruce, and fir; also *Pseudotsuga taxifolia* and *Larix occidentalis*. All of the records show that it was predaceous upon or associated with barkbeetles, principally *Dendroctonus*.

Observations by Hopkins, Burke, Webb, Edmonston, Fiske, Brunner, Champlain.

ENOCLERUS ICHNEUMONEUS Fabricius.

Is important as a predator on *Scolytus 4-spinosus* in hickory. Reared from *Juniperus virginiana* infested with *Phloeosinus* and *Cerambycidae*; also from sweet gum and maple.

The adults are diurnal and crawl over infested trees during sunny days. They prey upon *Scolytus* and other insects and are usually very abundant where they occur. The adults may be found through-

out the summer months, and finally crawl into cracks or beneath thick bark, where they overwinter. I have observed 15 or 20 individuals packed together beneath the thick bark of a dead tree during the winter months in Pennsylvania.

The larvae are to be found in the larval mines and galleries of the host. In the case of *Scolytus 4-spinosus*, they are very beneficial and consume large numbers of the broods. Pupae not observed.

Recorded from Pennsylvania, New Jersey, North Carolina, South Carolina, West Virginia, Virginia.

Observations by Fiske, Hopkins, Van Horn, Knull, Champlain.

ENOCLERUS QUADRISIGNATUS Say.

All of the forest insect records as well as my own show that this species is principally a predator on *Scolytus 4-spinosus*. It is abundant where it occurs.

The adults are nocturnal and may be observed at night, by the aid of a strong light, running over the Scolytus-infested trees, feeding upon the *Scolytus* and other insects attracted to these trees. I have observed an adult carrying off the adults of *Saperda discoidea* that were ovipositing in the tree.

Adults were observed during June, July, and August. They are attracted to light and may be caught with trap lanterns. Mating and ovipositing take place at night.

The adults are hidden during the daytime beneath bark, in cracks or in debris at base of tree.

Eggs are placed in the entrance gallery of *Scolytus*. The larvae upon hatching begin their travel into the galleries and through the mines of the *Scolytus*, feeding as they go. They consume a large quantity of the *Scolytus* broods.

Larvae of this species overwinter in the *Scolytus* larval mines. No pupae were observed.

Recorded from Pennsylvania, North Carolina, West Virginia, Missouri.

Observations by Kirk, Hopkins, Kirk, Champlain.

ENOCLERUS LUNATUS Spinola.

Notes by W. F. Fiske: "This species has been very frequently noted and taken crawling over peach trees which have been attacked by *Scolytus rugulosus* in Georgia."

During June and July the adults may be found on flowers and foliage. It is more of a southern species.

Recorded from Georgia and North Carolina, Fiske; Falls Church, Virginia, J. N. Knull. New Jersey, E. Daecke.

ENOCLERUS PALMI Schaeffer.

Waldo Canon, El Paso County, Colorado, May 10. Adult on bark surface of trees infested with *Dendroctonus ponderosae;* at elevation

of 7,500 feet; also from tanglefoot screen June 25, W. D. Edmonston.

Catalina Mountains, Arizona. Collected by M. Chrisman. Clerid larva from yellow-pine limb. Reared at eastern station.

ENOCLERUS CUPRESSI Van Dyke.

Pacific Grove, California, November 14. Reared from cones of *Cupressus macrocarpa* J. M. Miller.

Genus TRICHODES Herbst.

The adults of *Trichodes* may be found during the daytime on flowers, where they feed upon the pollen. They do not seem to be predaceous in the adult stage.

The larvae of the species studied are predaceous on the larvae of bees, wasps, etc., and may also feed upon the pollen or material stored as food for the bee larvae.

Trichodes larvae may be found in the cells of bees and wasps in logs, stumps, and the stems of plants, or in the hives of domestic bees.

TRICHODES ORNATUS Say.

Is a predator in the larval stage on the larvae of bees and wasps.

Adults.—In Colorado the adults are very common and are found on flowers from June to September, and range from 6,000 to 10,000 feet elevation. They feed upon the pollen of flowers and are not predaceous in the adult stage. Mating takes place at this time.

Larvae occur in the cells and galleries of bees and wasps in dead logs and stumps. They are predaceous on the larvae of bees or wasps, and possibly feed upon material stored by the parent bees for their young.

Mature larvae pupate in the spring and emerge in June. Is known from most of the Western States. Observations by Champlain.

TRICHODES APIVORUS Germar.

Adults occur on flowers, June to August. Are pollen feeders. Larvae are predaceous in the nests of bees and wasps.

Distribution, Pennsylvania, New Jersey, New Mexico, Texas, Colorado, North Carolina.

TRICHODES NUTTALLI Kirby.

Adults occur on flowers, June to August. Are pollen feeders. Larvae are predaceous in nests of bees and wasps.

Distribution, Indiana, Wisconsin, South Dakota, Pennsylvania.

Genus HYDNOCERA Newman.

The adults may be found flying or resting on foliage during sunny days and may be collected with the sweep net on low herbage.

The larvae are predaceous on the larvae of small woodborers, the larvae of gallmakers, and on the larvae of insects inhabiting the pith of annual plants.

HYDNOCERA UNIFASCIATA Say.

Tryon, North Carolina. Larvae from galleries of *Hyperplatys* in sumac. W. F. Fiske.

HYDNOCERA VERTICALIS Say.

Harrisburg, Pennsylvania. Larvae reared from Celastrus infested with Cerambycidae. F. C. Craighead. Lyme, Connecticut, *Hydnocera* larvae apparently predaceous on *Phymatodes amoenus* in wild grape. Champlain.

HYDNOCERA TABIDA LeConte.

East Falls Church, Virginia. Hydnocera pupae in stems of annual plant infested with *Mordellid* larvae. Champlain.

Genus XENODOSUS Wolcott.

XENODOSUS SANGUINEUS Say.

Adults collected at night on oak bark near base of tree, June, July. Adults collected in winter months at base of oak. Pennsylvania, Connecticut. Champlain.

Camp Caribou, Maine, May 28. Adults on bark of spruce trees dead and dying from attack of *Dendroctonus piceaperda*. June 7, adult on spruce infested with *Polygraphus* (placed living *Polygraphus* in bottle with it, which it at once attacked and slowly killed by biting at base of prothorax.) Webster Springs, West Virginia, June 20. Adult on decaying wound in living beech.

Waterville, New Hampshire, May 2. Adult under loose bark of large dead white pine. Observations by A. D. Hopkins.

Genus PHYLLOBAENUS Spinola.

PHYLLOBAENUS DISLOCATUS Say.

Is a predator on small Scolytoids and other small borers. Adults observed feeding on *Pityophthorus* attacking red oak. Are active during daytime, April to August. They may be found on and flying about infested trees where they feed, mate, and oviposit.

The larvae are to be found in the larval mines of small wood and bark borers, where they prey upon the borer broods. They are predaceous on *Elaphidion villosum* in oak twigs; *Chramesus icoriae* in hickory twigs; *Micracis* in redbud; *Scolytus mutica* and *Agrilus lecontei* in hackberry; and will probably attack almost any small borers in deciduous trees.

Probably occurs in most of the eastern half of the United States, southwest to Texas.

Observations by Hopkins, Fiske, Craighead, Kirk, Champlain.

PHYLLOBAENUS MERKELI Horn.

Is a predator on barkbeetles, Jeffery pine infested with Ips, alligator juniper infested with *Phloeosinus* and reared from cypress. New Mexico, Arizona, and California. Observations by Hopkins, Webb, and Chrisman.

Genus NEICHNEA Wolcott and Chapin (*ELLIPOTOMA Spinola; ICHNEA Castelnau*).

NEICHNEA LATICORNIS Say.

Is one of the principal enemies of the smaller *Scolytoidea* in the east. Is a predator on *Phloeosinus* in *Juniperus virginiana* and *Taxodium distichum*, *Chramesus icoriae*, and sometimes *Scolytus 4-spinosus* in hickory, *Phloeophthorus* in Morus, *Phloeophthorus* in *Cercis canadensis*, *Phloeotribus* in Celtis and many other *Scolytoids* in various trees.

The adults are active during the summer months, June to August. They are diurnal and can be found running over or resting on infested twigs or on foliage.

The eggs are laid in or at the entrance gallery of host. The larvae are to be found in the primary egg gallery of the *Scolytoid.* They feed upon the dead parent adults, the eggs and first larvae of their host. But one larva of the Clerid occurs in the primary egg gallery of the *Scolytoid.*

The Clerid larva when mature remains in the primary egg gallery where it overwinters. It probably feeds to some extent on the moisture, etc., in the gallery, but does not follow the larvae of host into their mines, nor does it wander from the gallery.

Prepupal larvae and first pupae may be found in the spring (May 26, at Westbury, Long Island, New York). Adults emerge in June. In localities where two generations of the host occur it is very probable that there will be two generations of the predator.

The pupae occur bare in the primary egg gallery of the host. No protective covering or whitish exudation observed.

Distribution: Pennsylvania, New Jersey, Connecticut, West Virginia, Virginia, Florida, Maryland, North Carolina.

Observations by Fiske, Hopkins, Craighead, Champlain.

Genus CHARIESSA Perty.

CHARIESSA ELEGANS Horn.

Is a predator on various woodborers in deciduous trees. Adults crawling over bark of oak trees blown over preceding winter, Placerville, California, February 15. H. E. Burke.

Larvae and adults in pupal cells of *Xylotrechus conjunctus* in *Quercus californicus*, Walker, California, August 28. F. C. Craighead.

Larvae from Cerambycid galleries in Oregon oak, Ashland, Oregon. G. Hofer, collector.

Larvae from Neoclytus-infested white oak, Catalina Mountains, Arizona. M. Chrisman, collector.

CHARIESSA PILOSA Forster.

Is a predator on primary and secondary wood and bark borers, among which are *Scolytus 4-spinosus* and *Magdalis olyra* in hickory; Cerambycid and Buprestid borers beneath bark and in wood. Is the most common eastern Clerid. It has been reared from oak, hickory, walnut, sassafras, linden, grape, birch, chestnut, and rarely in coniferous trees. It undoubtedly attacks borers in any tree or wood.

Adults begin to emerge during May and June and are attracted to infested trees. They are active during daytime and may be seen throughout the summer months, mating, ovipositing, and searching for prey. They feed upon small insects that are attracted to the infested trees. The eggs are placed in crevices in the bark or in wounds and galleries made by the borers.

Upon hatching the larvae begin at once to search for prey, traveling through the larval mines of the borers. In relation to *Magdalis olyra* in hickory saplings, the Clerid larvae were about one-fourth inch long by August 15. They fed until cold weather arrived, being three-eighths to one-half grown. They overwintered in the mines of the host, resuming the attack in the spring. These larvae continued in this tree for one year after the *Magdalis* had emerged, making a total of two years in the larval stage.

During the second year they were found in the galleries and mines of secondary borers. Overwintered again in immature larval stage, pupating in the spring. Whether this was the exception or the rule is yet to be determined, although some unfinished observations in connection with *Scolytus 4-spinosus* were very similar.

First pupae observed May 12 to 15 (Connecticut and New York) in trees abandoned by barkborers previous June.

C. pilosa does not construct a special pupal cell, but utilizes the gallery or cell of a wood borer. The pupae are bare in the cell.

Distribution: Eastern half of the United States.

Observations made by most of the attachés of the forest insect branch.

Genus PELONIUM Spinola.

PELONIUM LEUCOPHAEUM Klug.

Reared from branches of *Taxodium* containing young larvae of Cerambycidae; also from section of small cypress. Adult collected flying about cut branches of juniper containing Cerambycid larvae November 21. Observations by W. F. Fiske.

Genus GALERUCLERUS Gahan (*CREGYA*).

GALERUCLERUS OCULATUS Say.

Is a predator on Scolytoids and secondary wood borers in conifers and deciduous trees. *Scolytus* infesting *Pinus rigida; Pogonocherus* infesting *Pinus rigida; Liopus* and *Scolytoids* in Rhus; *Liopus* in Virginia creeper.

Adults taken at trap lantern in May, also by sweeping low herbage.

Larvae were observed at Westbury, Long Island, New York, in Pitch Pine stems. Tops attacked by *Pityophthorus*, bases by *Pogonocherus*. Clerid larvae were found in the *Pityophthorus* mines and in the cells of *Pogonocherus*. The latter were utilized as pupal chambers. The pupal cell was slightly lined with the frothy exudation and the frass at each end of the cell was cemeted together.

Recorded from Pennsylvania, New York, West Virginia, District of Columbia, North Carolina.

Observations by Hopkins, Fiske, Van Horn, Champlain.

Genus ORTHOPLEURA Spinola.

ORTHOPLEURA DAMICORNIS Fabricius (not Klug).

Is predaceous on borers in dead and dying deciduous trees. Reared from chestnut and oak infested with *Chrysobothris femorata;* oak infested with *Neoclytus longpipes;* sassafras infested with *Curculionids;* ash infested with *Obrium;* hickory, grape, locust, and persimmon infested with secondary borers; and red oak infested with *Tillamorpha geminata.*

Adults are nocturnal; may be observed at night on infested trees, April to July; at arc lights, or taken in trap lanterns. Usually hide during daytime in crevices and beneath bark.

Larvae occur in the galleries and mines of host. In a note by W. F. Fiske, made April 20, 1904, at Tryon, North Carolina, he writes: "Newly hatched Clerid larva found to-day attached to *Chrysobothris femorata* larva."

Distribution: Virginia, Pennsylvania, North Carolina, Georgia, Maryland.

Observations by Hopkins, Fiske, Craighead, Kirk, Champlain.

Genus ENOPLIUM Latreille.

ENOPLIUM QUADRIPUNCTUM Say.

Bred from dead black walnut branches by A. D. Hopkins, Wood County, West Virginia, April, 1890.

PART III.

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PART IV.

EXPLANATION OF PLATES.[1]

A 1—First abdominal segment.
A 2—Second abdominal segment.
aa—Alar area.
af—Angulus frontalis.
Amp—Ampulla (fig. 112).
apx—Apex of mandible (fig. 48).
bm—Basal membrane of antenna.
bp—Basal plate of cerci (figs. 79 and 121).
c—Clypeus.
ca—Cardo maxillae.
cer—Cercus.
cond—Condyle below angulus frontalis for dorsal articulation of the mandible (fig. 116).
cox—Coxa.
dl—Dorso-lateral suture.
dn—Dorsal nodus (=dorsal notch).
ecr—Epicranium.
el—Epipleural lobe.
ep—Epistoma.
epx—Epipharynx (fig. 116).
epxp—Epipharyngeal plate (fig. 116).
er—Epipharyngeal rod (fig. 116).
es—Eusternum (=Basisternum).
f—Frons.
fe—Femur.
fil—Supplementary, jointlike appendix on second antennal joint.
fs—Frontal suture.
g—Longitudinal groove of mandible (fig. 48).
gu—Gula.
gus—Gular suture.
hp—Hypopleurum.
hr—Hypopharyngeal rod (fig. 31).
hs—Hypopleural suture.
hy—Hypopharynx (fig. 81).
I S—Intersegmental membrane, containing prescutal, epipleural, and poststernellar elements.
l—Labrum.
la—Mala maxillae.
lig—Ligula (or mala labii).
lin—Lingua (fig. 31).
ln—Lateral nodus (=lateral notch).
lsl—Laterosternellum.
m—Mentum.
md—Mandible.
mh—Maxillary, anterior margin of hypostoma.
mstl—Mediosternellum.
Ms—Mesothorax.
Mstg—Mesotergite.
Mt—Metathorax.
Mttg—Metatergite.
oc—Ocellus.
pa—Parascutum.
pas—Parasternum.
pe—Preepipleurum.
pgc—Chitinization of palpiger maxillae (fig. 82).
pgm—Palpiger maxillae.
plg—Palpiger labii.
pgu—Paragular plate.
ph—Prehypopleurum.
pli—Palpus labii.
pls—Pleurostoma.
pmx—Palpus maxillae.
pn—Pleural nodus (=pleural notch).
poe—Postepipleurum.
poh—Posthypopleurum.
pos—Postscutellum.
post—Poststernellum.

[1] Drawings by Adam G. Böving.

*pres*____ Preeusternum.
*Pr*_____ Prothorax.
*Prtg*____ Prothoracic tergal region.
*psc*_____ Prescutum.
*pst*_____ Presternum.
(*pst*1–3_ Presterna pertaining to the thoracic segments.
pst 4–5_ Presterna pertaining to the abdominal segments.)
*r*_______ Retinaculum of mandible (fig. 48).
*sc*______ Scutum.
*scl*_____ Scutellum.
*sc-scl*___ Scuto-scutellar suture.
*sli*_____ Stipes labii (with palpiger labii, *plg*, and mala labii, *lig.*).
*sm*_____ Submentum.
*sn*______ Sternal nodus (= sternal notch).
*sp*______ Spiracle.
*st*______ Stipes maxillae.
*stl*______ Sternellum.
*stp*_____ Sternal plate.
*ta*______ Tarsus.
*tb*______ Tentorial bridge (?) (fig. 31).
*tea*_____ Tentorial arm (fig. 31).
*tib*_____ Tibia.
tro Trochanter.
*vl*______ Ventro-lateral suture.
*vn*______ Ventral nodus (= ventral notch).
*I*_______ First or proximal joint of antenna.
*II*______ Second joint of antenna.
*III*_____ Third or apical joint of antenna.

PLATE 42.

STRUCTURAL DETAILS OF LARVAE OF FAMILY CLERIDAE. SLIGHTLY DIAGRAMMATIC.

FIG. 1. Ventral view.
2. Lateral view.
3. Dorsal view.

PLATE 43.

LATERAL VIEW OF HEAD STRUCTURES.

FIG. 4. *Enoclerus sphegeus.*
5. *Chariessa pilosa.*
6. *Phyllobaenus dislocatus.*
7. *Neichnea laticornis.*
8. *Trichodes ornatus.*
9. *Tarsostenus univittatus.*
10. *Cymatodera undulata.*
11. *Cymatodera morosa.*
12. *Orthopleura damicornis.*
13. *Monophylla terminata.*
14. *Priocera castanea.*
15. *Thaneroclerus girodi.*
16. *Hydnocera verticalis.*

PLATE 44.

DORSAL VIEW OF HEAD STRUCTURES.

FIG. 17. *Enoclerus ichneumoneus.*
18. *Enoclerus muttkowskii.*
19. *Enoclerus sphegeus.*
20. *Chariessa pilosa.*
21. *Phyllobaenus dislocatus.*
22. *Neichnea laticornis.*
23. *Trichodes ornatus.*
24. *Cymatodera morosa.*

FIG. 25. *Tarsostenus univittatus.*
26. *Orthopleura damicornis.*
27. *Monophylla terminata.*
28. *Priocera castanea.*
29. *Thaneroclerus girodi.*
30. *Hydnocera verticalis.*

PLATE 45.

VENTRAL VIEW OF HEAD STRUCTURES.

FIG. 31. *Enoclerus ichneumoneus:*
hr, Hypopharyngeal rod; *hy*, Hypopharynx (buccal surface above mentum and submentum); *lig*, Ligula (malae labii); *lin*, Lingua (buccal surface of labium); *s*, Maxillary buccal tooth; *tea*, tentorial arm; *tb* Tentorial bridge (?).
32. *Enoclerus sphegeus.*
pgo, Chitinization of palpiger maxillae.
33. *Chariessa pilosa.*
34. *Phyllobaenus dislocatus.*
35. *Neichnea laticornis.*
36. *Trichodes ornatus.*
37. *Tarsostenus univittatus.*
38. *Cymatodera morosa.*
39. *Orthopleura damicornis.*
40. *Monophylla terminata.*
41. *Priocera castanea.*
42. *Thaneroclerus girodi.*
43. *Hydnocera verticalis.*

PLATE 46.

MANDIBLES.

FIG. 44. *Thanasimus formicarius*, dorsal view.
45. *Thanasimus dubius*, dorsal view.
46. *Thanasimus formicarius*, ventral view.
47. *Enoclerus ichneumoneus*, ventral view.
48. *Enoclerus quadrisignatus*, ventral view.
apx, apex of mandible; *g*, groove along cutting edge (= caverna partis scissoriae); *r*, retinaculum (larger posterior tooth of cutting edge.)
49. *Enoclerus quadriguttatus*, ventral view.
50. *Enoclerus rosmarus*, ventral view.
51. *Enoclerus muttkowskii*, ventral view.
52. *Enoclerus sphegeus*, ventral view.
53. *Chariessa pilosa*, ventral view.
54. *Phyllobaenus dislocatus*, ventral view.
55. *Neichnea laticornis*, ventral view.
56. *Trichodes ornatus*, ventral view.
57. *Tarsostenus univittatus*, ventral view.
58. *Cymatodera morosa*, ventral view.
59. *Orthopleura damicornis*, ventral view.
60. *Monophylla terminata*, retinaculum.
61. *Priocera castanea*—(*a*) ventral view; (*b*) dorsal view.
62. *Thaneroclerus girodi*, ventral view.
63. *Hydnocera verticalis*, ventral view.

Plate 47.

LATERAL VIEW OF CERCI.

Fig. 64. *Enoclerus ichneumoneus.*
65. *Enoclerus quadrisignatus.*
66. *Enoclerus quadriguttatus.*
67. *Enoclerus rosmarus.*
68. *Enoclerus muttkowskii.*
69. *Enoclerus sphegeus.*
70. *Chariessa pilosa.*
71. *Phyllobaenus dislocatus.*
72. *Neichnea laticornis.*
73. *Trichodes ornatus.*
74. *Tarsostenus univittatus.*
75. *Monophylla terminata.*
76. *Priocera castanea.*
77. *Orthopleura damicornis.*
78. *Thaneroclerus girodi.*

Plate 48.

DORSAL VIEW OF CERCI (EXCEPT FIGURES 87 AND 88, WHICH GIVE THE VENTRAL VIEW).

Fig. 79. *Thanasimus formicarius.*
bp, basal plate carrying the cerci; *cer.* cercus.
80. *Thaneroclerus dubius.*
81. *Enoclerus ichneumoneus.*
82. *Enoclerus quadrisignatus.*
83. *Enoclerus quadriguttatus.*
84. *Enoclerus rosmarus* (outline drawing).
85. *Enoclerus muttkowskii.*
86. *Enoclerus sphegeus* (outline drawing; *cfr.* fig. 121).
87. *Chariessa elegans*, ventral view of cerci.
88. *Chariessa pilosa*, ventral view of cerci.
89. *Chariessa pilosa*, dorsal view of cerci.
90. *Phyllobaenus dislocatus.*
91. *Neichnea laticornis.*

Plate 49.

DORSAL VIEW OF CERCI.

Fig. 92. *Trichodes ornatus.*
93. *Tarsostenus univittatus.*
94. *Cymatodera undulata* (outline drawing).
95. *Cymatodera morosa.*
96. *Cymatodera inornata* (outline drawing).
97. *Monophylla terminata.*
98. *Priocera castanea.*
99. *Orthopleura damicornis.*
100. *Thaneroclerus girodi;* first stage larva.
101. *Thaneroclerus girodi;* mature larva.
102. *Hydnocera verticalis.*

Plate 50.

LATERAL VIEW OF LARVA.

Fig. 103. *Thanasimus formicarius.*
104. *Enoclerus sphegeus.*
105. *Trichodes ornatus.*

PLATE 51.

LATERAL VIEW OF LARVA.

FIG. 106. *Neichnea laticornis.*
107. *Tarsostenus univittatus.*
108. *Orthopleura damicornis.*
109. *Monophylla terminata.*
110. *Priocera castanea.*

PLATE 52.

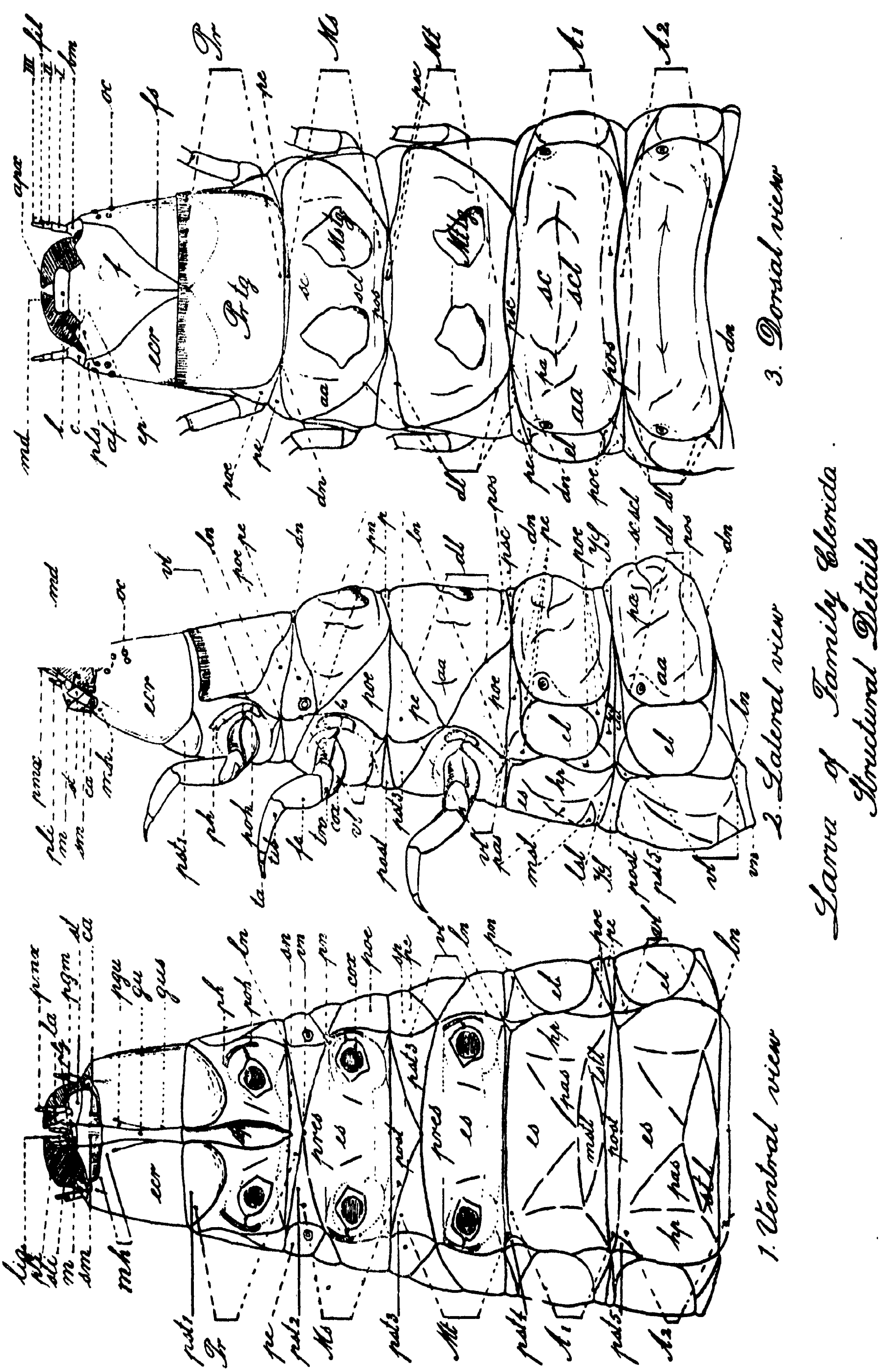
DORSAL VIEW OF LARVA.

FIG. 111. *Thanasimus formicarius.*
112. *Chariessa pilosa.*
113. *Thaneroclerus girodi.*
114. *Cymatodera morosa* (color pattern indicated).

PLATE 53.

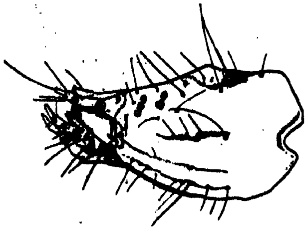
MISCELLANEOUS STRUCTURES.

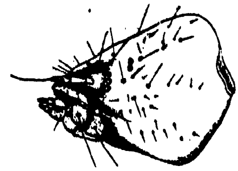
FIG. 115. *Enoclerus sphegeus;* dorsal view of head, thorax, and the two first abd. segments.
116. *Enoclerus sphegeus;* view from buccal cavity.
cond., Condyle below anglus frontalis for dorsal articulation of mandible; *epx*, Epipharynx; *epxp*, Epipharyngeal plate; *er*, Epipharyngeal rod; *f*, Underside of frontal shield.
117. *Enoclerus quadrisignatus;* left maxilla with, as seen from buccal cavity, dorsal membranous walls of stipes and cardo removed. *s*, maxillary buccal tooth.
118. *Hydnocera verticalis;* ventral view of ventral mouth parts.
119. *Enoclerus sphegeus;* Posterior angle of frontal shield from the underside. *eca*, frontal endocarina.
120. *Hydnocera verticalis;* right antenna from above.
121. *Enoclerus sphegeus;* dorsal view of 7th, 8th, and 9th abdominal segments.
122. *Thanasimus formicarius;* ventral view.
123. *Phyllobaenus dislocatus;* dorsal view.
124. *Cymatodera morosa;* annular spiracles of the mesothoracic and third abdominal segments.
125. *Enoclerus ichneumonoides;* the pseudoannular spiracles of the mesothoracic and third abdominal segments, and the bifore spiracle of eighth abdominal segment.
126. *Thaneroclerus girodi;* bifore spiracles of the mesothoracic and third abdominal segments.
127. *Phyllobaenus dislocatus;* ventral view of the three thoracic and two first abdominal segments. *stp*, Prothoracic sternal plate.
128–132. Lateral view of left leg of the third pair.
128. *Trichodes ornatus.*
129. *Neichnea laticornis.*
130. *Cymatodera morosa.*
131. *Orthopleura damicornis.*
132. *Hydnocera verticalis.*
133. *Phyllobaenus dislocatus;* dorsal view of 7th, 8th, and 9th abdominal segments.

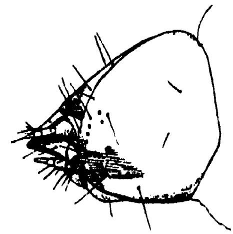


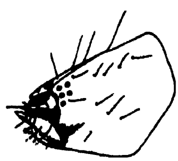
LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

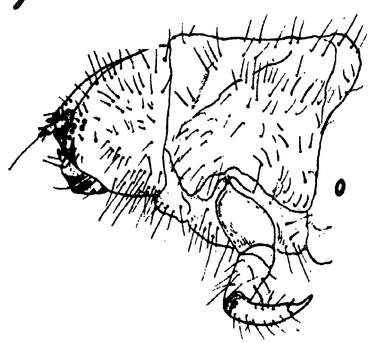
FOR EXPLANATION OF PLATE SEE PAGES 645 AND 646.

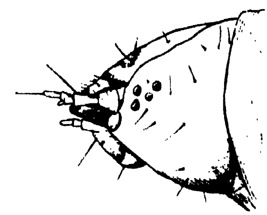

4. Enoclerus sphegeus

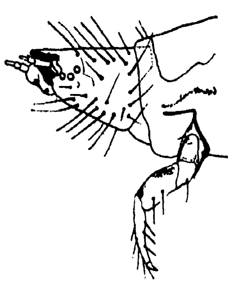

5. Chariessa pilosa

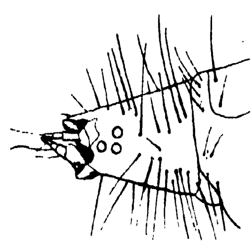

6 Phyllobaenus


7. Neichnea

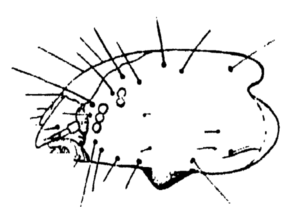

8. Trichodes ornatus

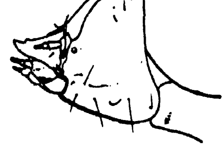

9 Tarsostenus


10. Cymatodera

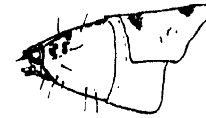

11 Cymatodera morosa


12. Orthopleura

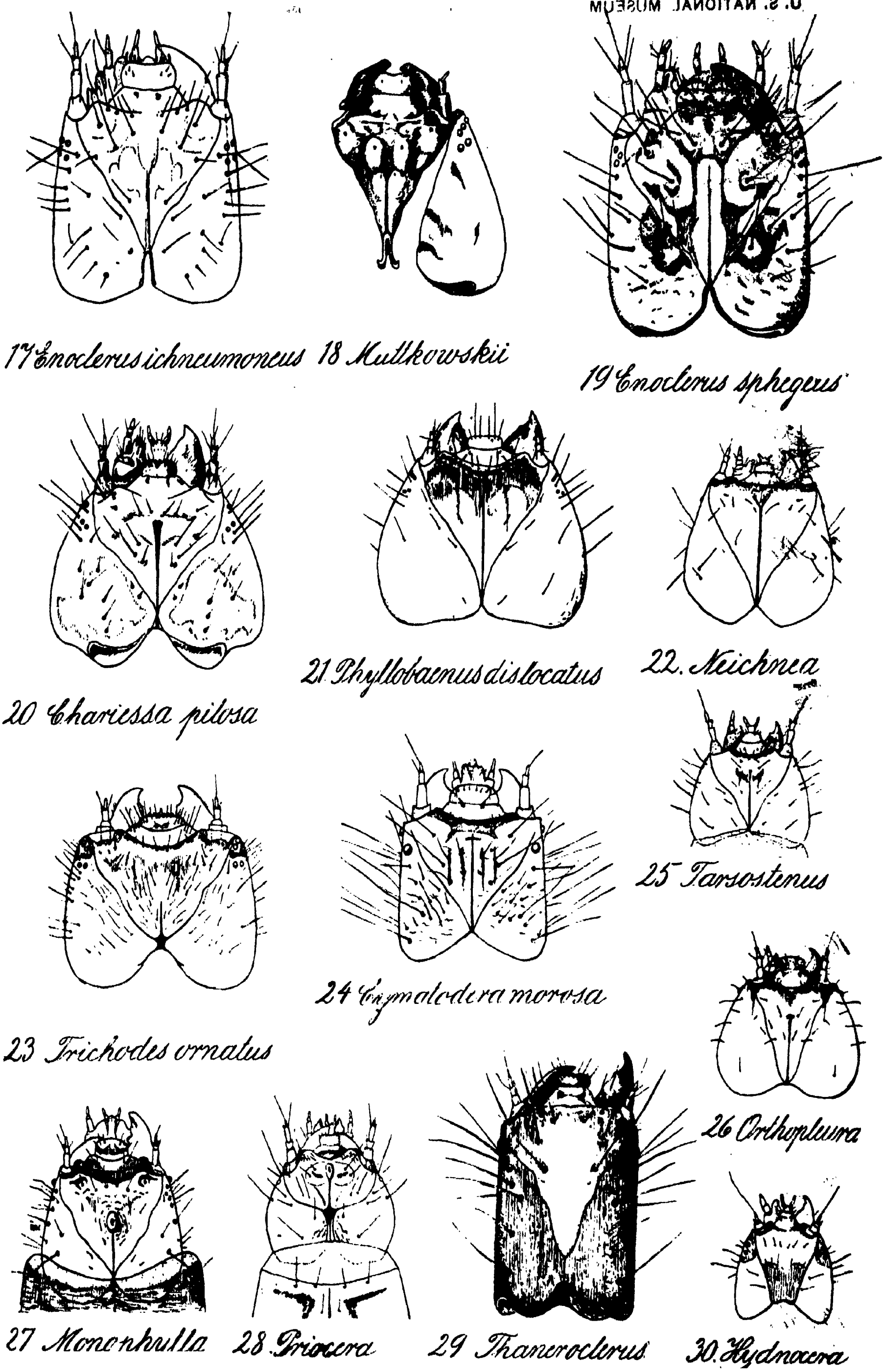

15. Thaneroclerus


, ylla


14. Priocera

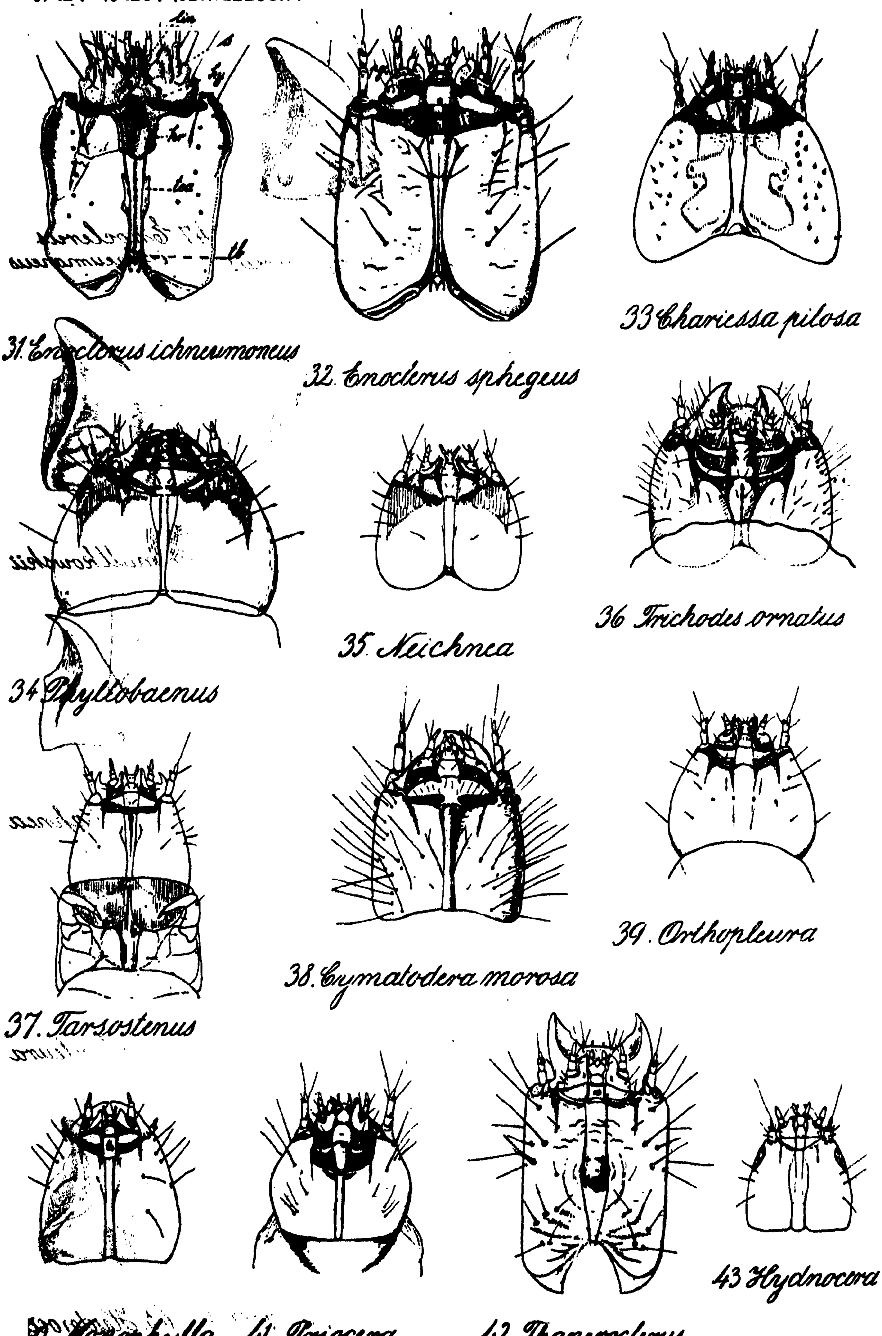

16. Hydnocera

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.



LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGES 646 AND 647.

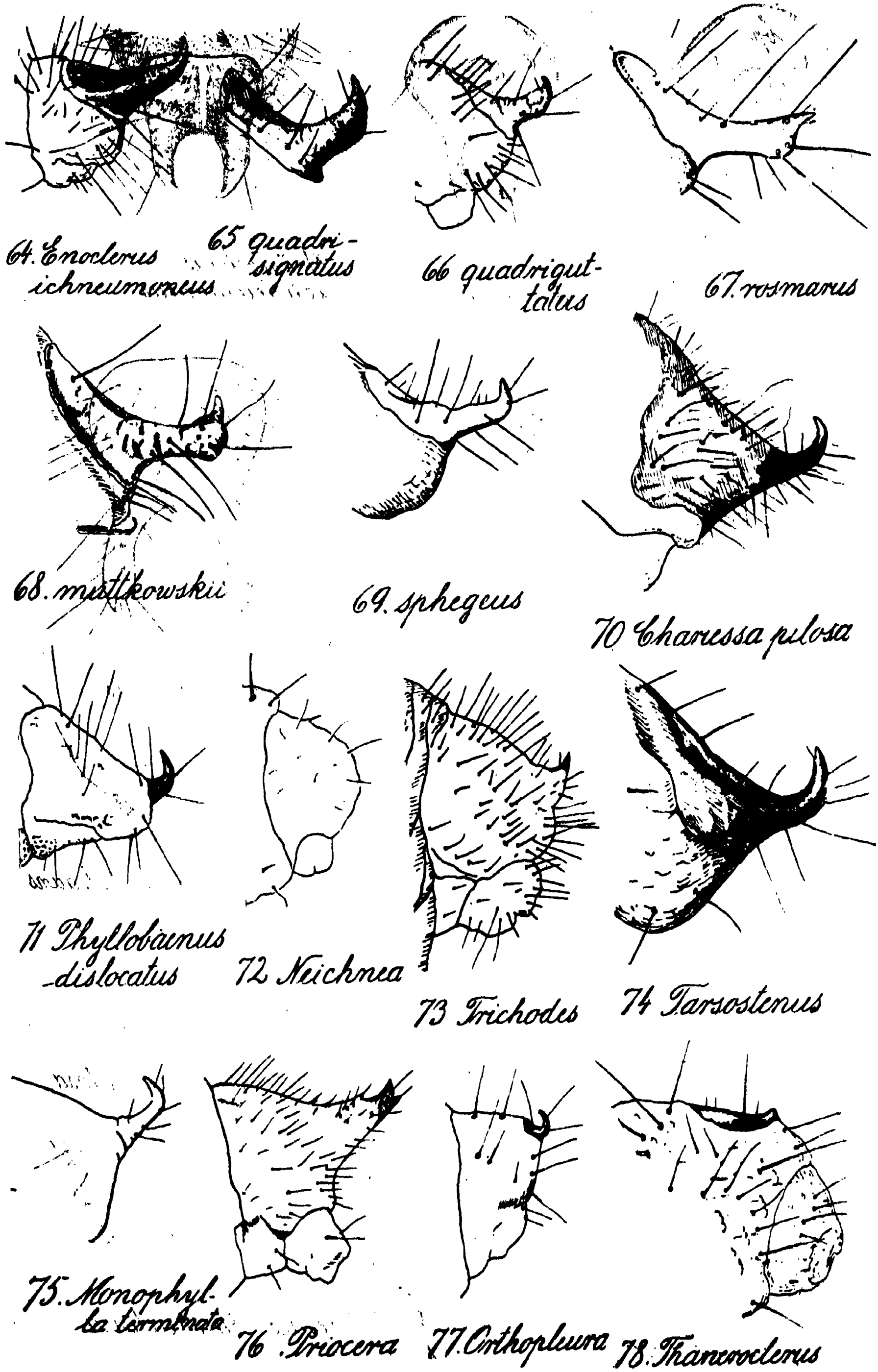


LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 847.

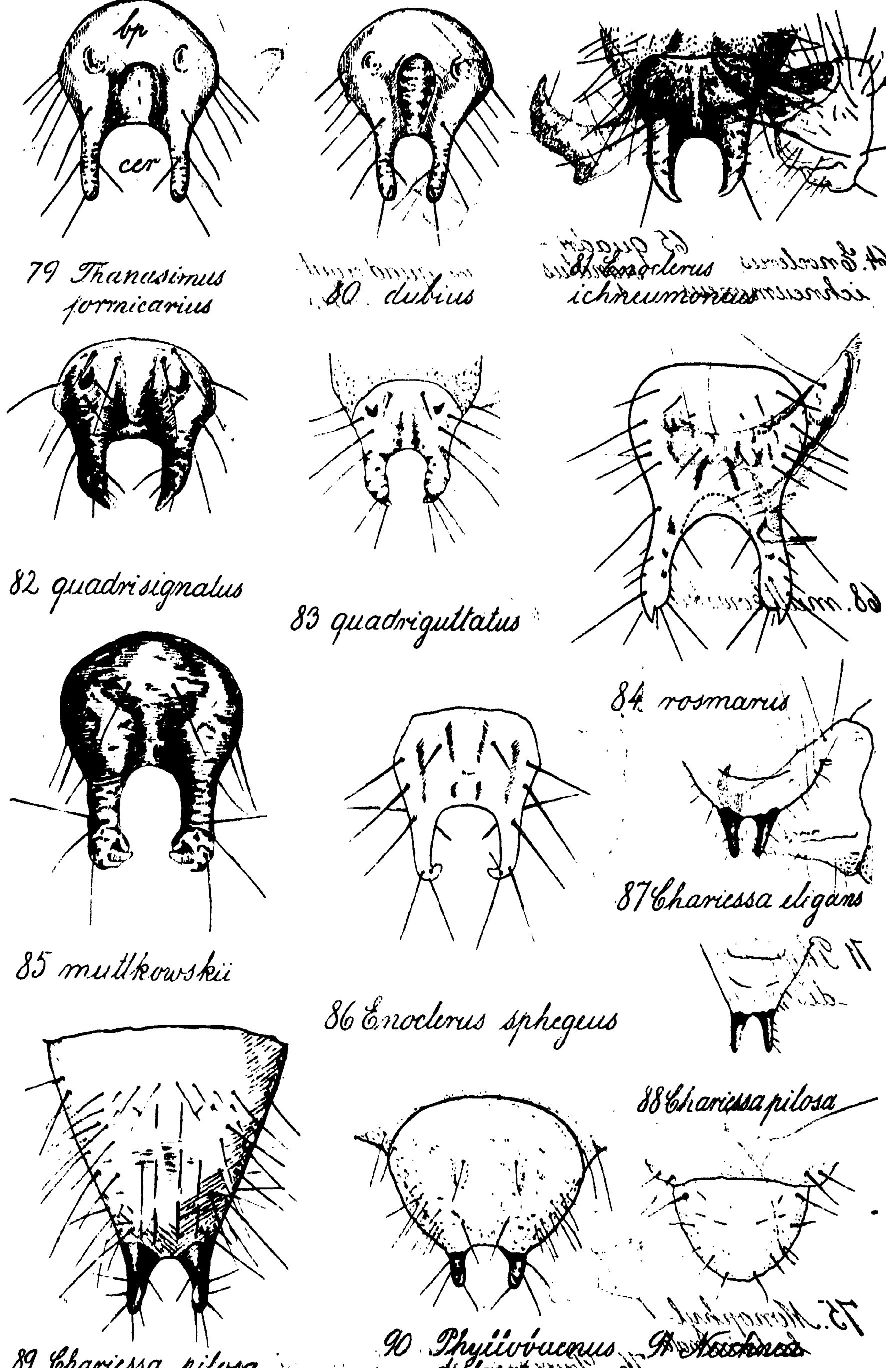
LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLER

For explanation of plate see page 847.



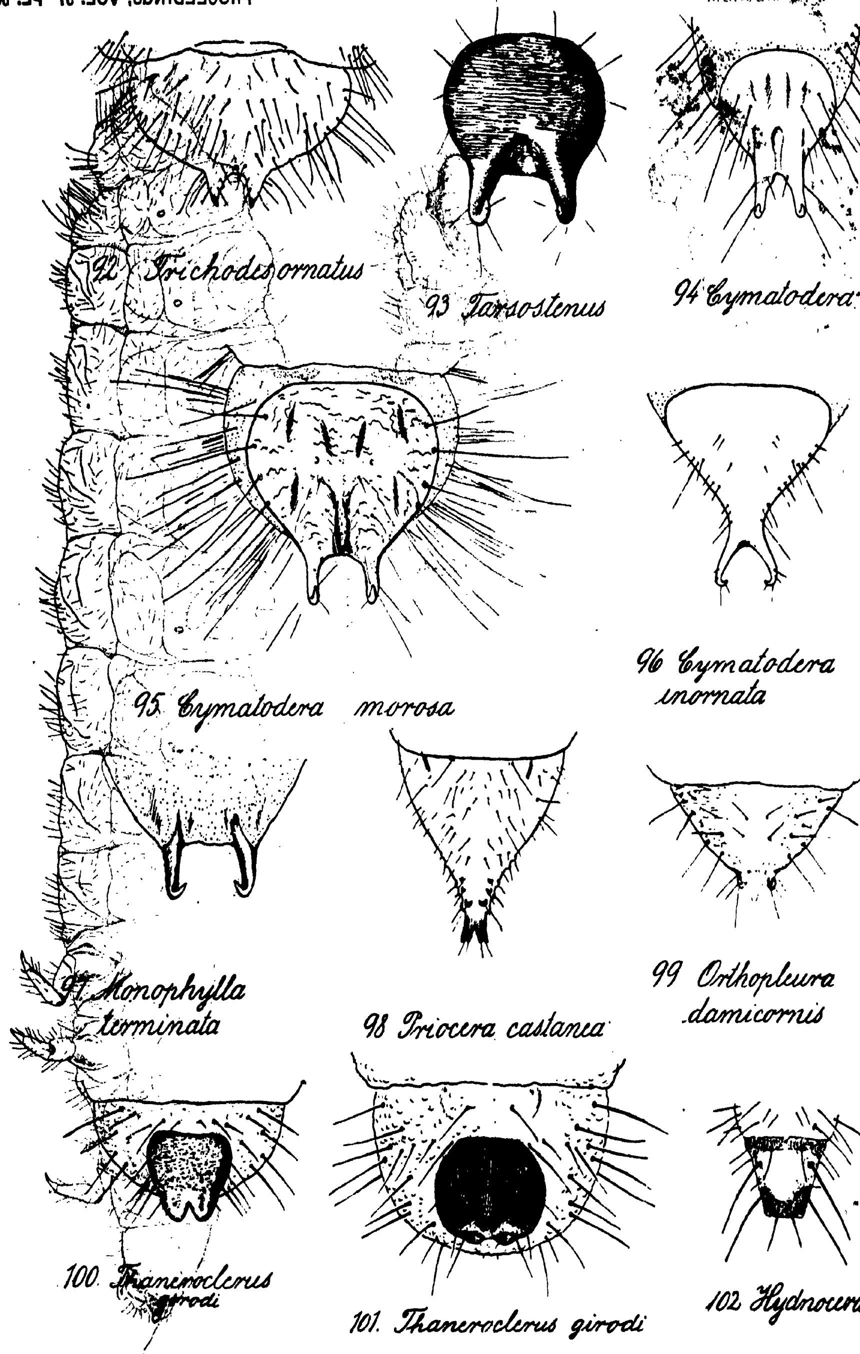
LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 648.



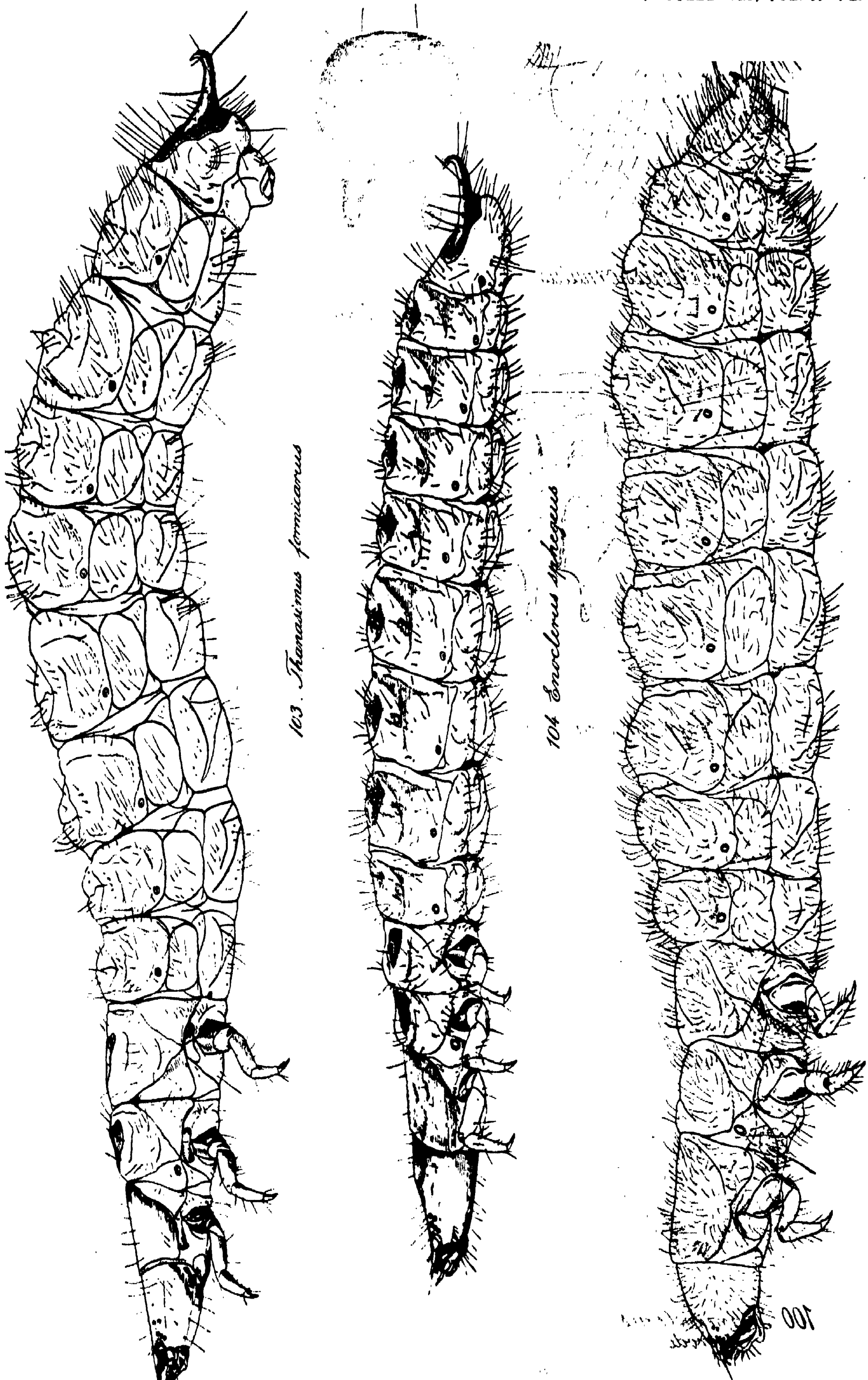
LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE

FOR EXPLANATION OF PLATE SEE PAGE 648.



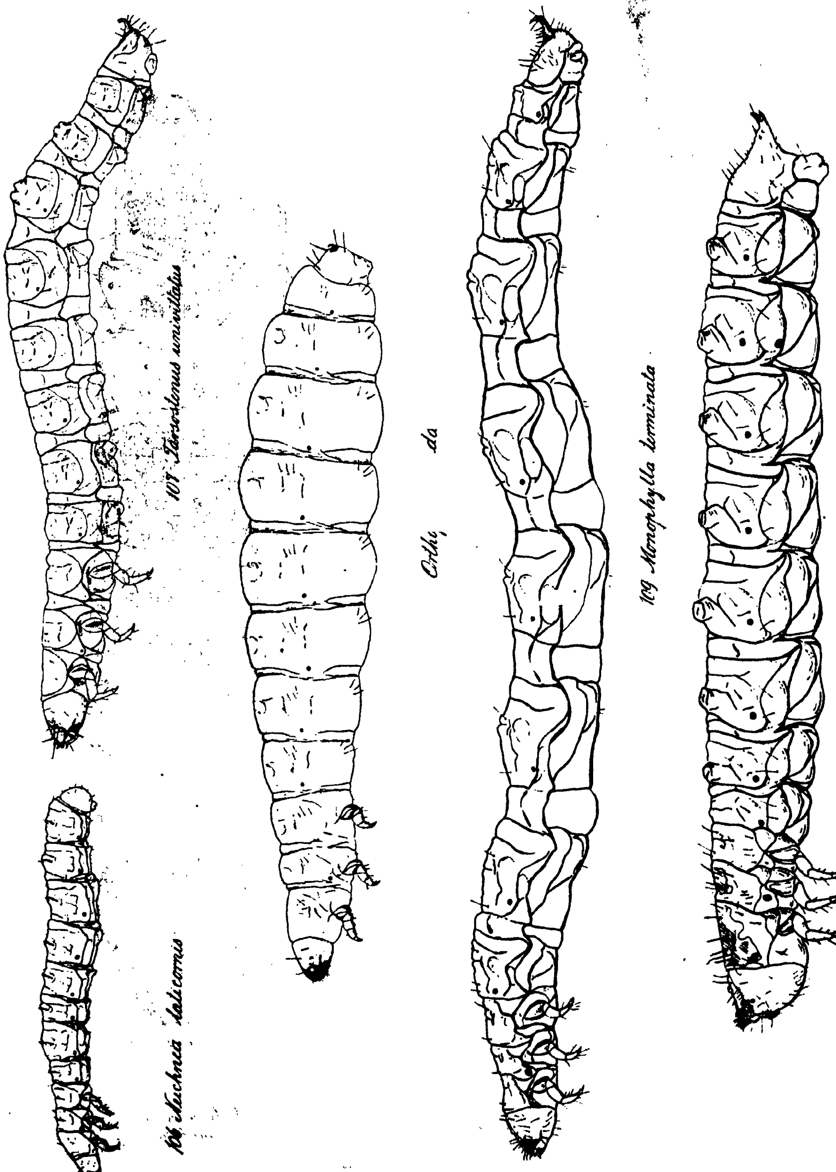
LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 648.



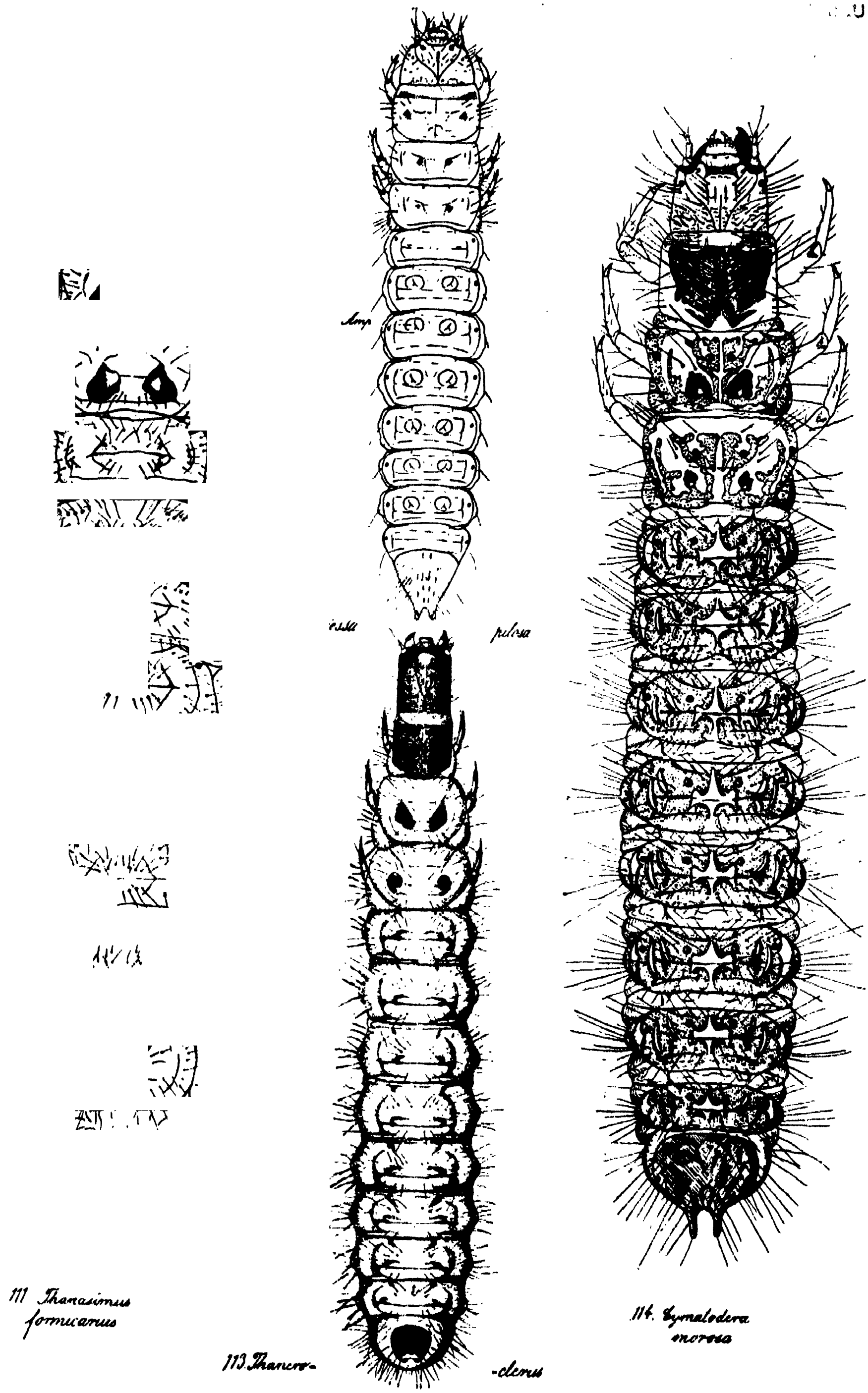
LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 648.



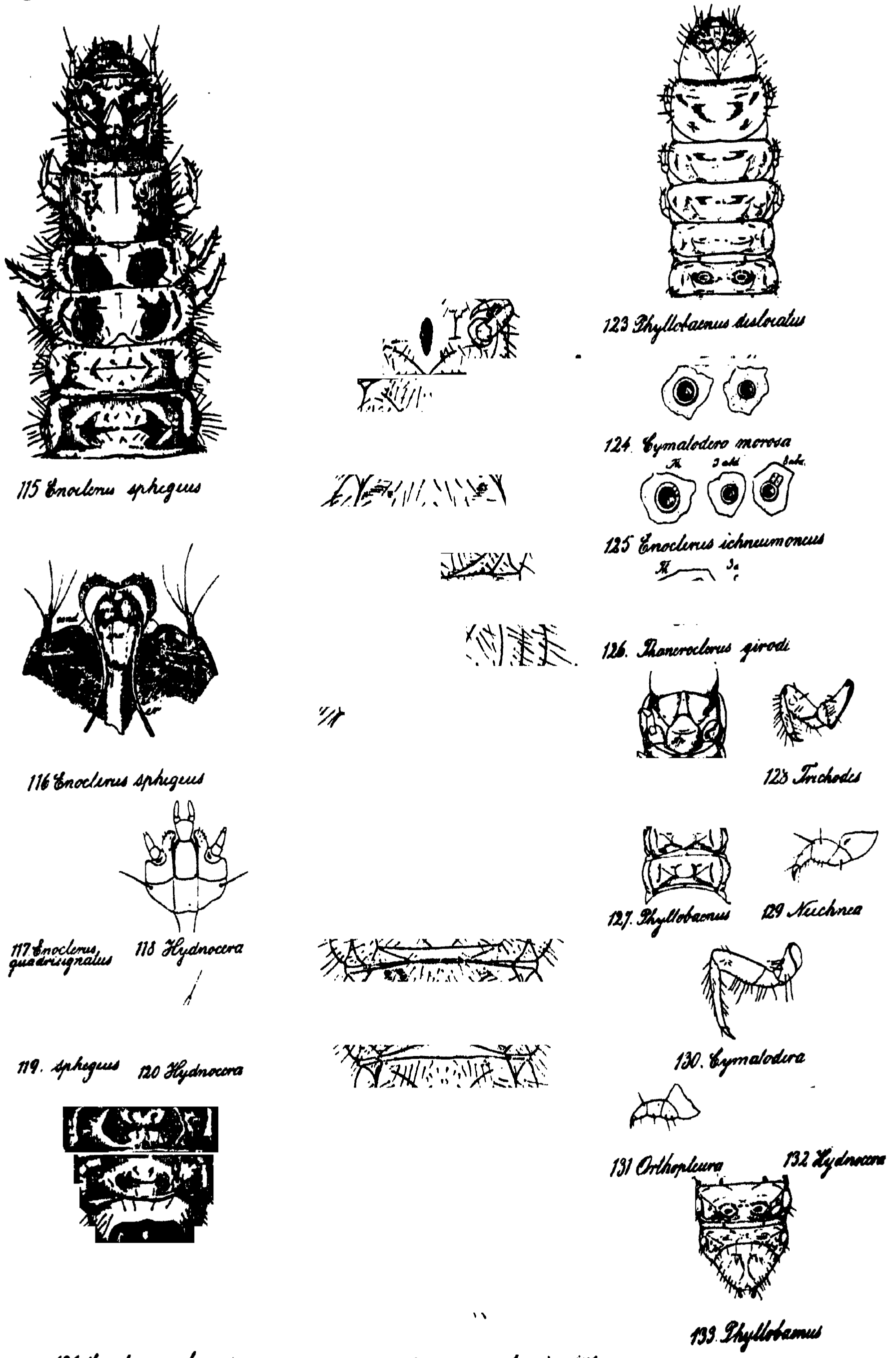
LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 649.



LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 649.



LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 549.

PLEISTOCENE PECCARIES FROM THE CUMBERLAND CAVE DEPOSIT.

By James Williams Gidley,

Assistant Curator, United States National Museum.

Remains of extinct peccaries are among the most abundant fossils found in the Cumberland Cave deposit, discovered a few years ago in the vicinity of Cumberland, Maryland.[1]

Two genera are recognized—*Platygonus* and *Mylohyus*—the former being represented by young and adult specimens of both sexes, pertaining to more than 30 individuals, which include one nearly complete skeleton and 15 more or less complete skulls. Compared with this abundant and good material *Mylohyus* is poorly represented. But the few specimens obtained of the latter, although fragmentary, also add something to our knowledge of this genus.

This material from the Cumberland Cave not only adds some new species to the list, but forms the basis of the following observations and definitions relative to the classification and relationships of the peccaries in general, which definitions have for their special object a clearer understanding of the Pleistocene species with which the present paper is more intimately concerned:

The first notice of fossil remains of Pleistocene peccaries was published in 1848[2] by John L. LeConte, who described under the name *Platygonus compressus* a few fragments of a skull and other bones found in a fissure deposit in the vicinity of Galena, Illinois. Since that time a considerable number of specimens, representing various species, have been described by other authors. Some of these descriptions and determinations were based on fragmentary material, others on material which included nearly complete skulls and skeletons. Yet always there seems to have been considerable confusion, only partially cleared up by the more recent writers, regarding the proper generic and specific distinctions, and even family

[1] A preliminary report of the occurrence and character of this deposit, together with an uncompleted list of the species represented, was published in August, 1913. Gidley, Proc. U. S. Nat. Mus., vol. 46 (1914), No. 2014, pp. 95, 96. This report has been supplemented by a semipopular account published in the Report of Smithsonian Institution for 1918, now in press.

[2] Amer. Journ. Sci., ser. 2, vol. 5, 1848, pp. 102–106; Mem. Amer. Acad. Arts Sci., vol. 3, 1848, pp. 257–274.

characterizations of this group have not been well defined. Thus vertebrate paleontologists have usually recognized only one living genus of peccaries, "*Dicotyles*" (=*Tayassu*), and to this group the earlier writers referred most of the fossil forms discovered, although it is now known that most, if not all, these species belong to extinct genera. There has likewise been a decided tendency among paleontologists to consider the peccary group as a whole as of only subfamily rank, although some later writers have followed the mammalogists in classifying the suillines under two distinct families, the Suidae and Tayassuidae, but they have done this without giving any particular reasons for this change of opinion; in fact there seems to have been considerable reluctance on the part of paleontologists in following the mammalogists both in their recognition of two distinct genera of living peccaries, and in admitting full family distictions between the peccaries and true pigs. A study of the literature suggests this attitude has been due, in part at least, to the lack in definitions given for living forms of characters based on osteological features. And added to this the idea seems to prevail among paleontologists that the known extinct forms, especially of the older formations, rather definitely unite the two suilline groups in a single family.

In this connection it may be stated that Matthew and Gidley[1] several years ago pointed out that the known peccaries, both living and extinct, are confined in their distribution entirely to the New World, while the true pigs seem as exclusively to belong to the Old World, and they expressed the opinon at that time that these two groups comprise subfamilies derived from "the primitive Suidae, common to both hemispheres in the Oligocene." Matthew later[2] somewhat modified this arrangement in giving full-family rank to the pig and peccary groups, and suggested their derivation, together with the Elotheriidae, "from a common Eocene ancestry." My present view fully accords with this later conclusion except that, from certain modifications observed in the earliest known forms, I believe the elotheres must have split off from the primitive ancestral group at a very much earlier date than that which marked the definite separation of the Suidae and Tayassuidae.

From the foregoing it seems evident that the definitions of the two families of suillines, and especially the two genera of living peccaries (one of which is not even now recognized by paleontologists), are in this connection in need of revision since these definitions have a special bearing on any attempt to clear up and make determinable the Pleistocene species of peccaries. I therefore deem them necessary to an intelligent description of any new material.

[1] Bull. Amer. Mus. Nat. Hist., vol. 20, 1904, p. 267.
[2] Idem., vol. 28, 1907, p. 216.

Hay seems to have realized this need in his brief study of the peccaries as indicated in his treatise on The Pleistocene Mammals of Iowa.[1] But he here redefined only, the family Tayassuidae and but one living genus, *Tayassu* (not recognizing the other), together with the two Pleistocene genera, *Platygonus* and *Mylohyus*. Moreover, Hay's definitions are based principally on characters of the dentition and are not adequate except for the purpose for which they evidently were intended, namely, of distinguishing the Pleistocene genera from the living peccaries and from each other. The following definitions are, therefore, here proposed:

Family SUIDAE.

1, Paired-toed ungulates, with diminishing lateral digits, but with median digits never coalesced, and with skull modified along the lines of a short cranium with high supraorbital region and more or less elongated facial region (in living forms, snout abruptly truncated, terminating in a vertically flattened and expanded pad.) 2, Dental series usually complete, and never with long diastema behind the canines, cheek-teeth brachyodont-bunodont in type; the premolars usually unreduced in numbers (in *Babirusa* and *Potamochoerus* reduced to $\frac{2}{2}$), always more simple than the molars, and not tending to become molariform; molars primarily four cusped, subquadrate, relatively large, the last of the series in the more recent forms tending to become greatly enlarged and lengthened by posterior addition of cusps, and accompanied with complexity of tubercles and enamel foldings; incisors usually $\frac{3}{3}$ (sometimes $\frac{2}{3}$ or $\frac{1}{3}$); premaxillae narrow, with alveolar border greatly lengthened, incisors, except in the more primitive forms, increasing in size from behind forward; lower incisors more or less procumbent in the later forms, the much elongated median two pairs converge forward so that the tips of both pairs come in full contact with the hinder surface of a single enlarged median pair above; canines (especially in the males) usually developed into large curved and formidable tusks, the upper pair directed outward and tending to recurve upward (extremely upturned in *Babirusa*), the lower pair irregularly triangular in cross section; 3, lachrymal large, extending well onto the face, widely separating the jugal from contact with the frontal; 4, zygomatic ridge of the maxillary separated from the side of the face by a wide rostral sulcus,[2] which extends backward above it nearly to the anterior border of the orbit; 5, basicranial plane nearly parallel with the plane of the palate (except in *potamochoerus;*) 6, glenoid fossae elevated above the basicranial plane, and lying near the external auditory meatus; 7, paroccipital processes usually produced

[1] Ann. Rept. Iowa Geol. Surv. for 1912, vol. 23, 1914, pp. 212–226.
[2] This sulcus carries the strongly developed snout muscles.

into long, peg-like protuberances which are directed downward and slightly forward, paralleling and usually closely appressed to the greatly elongated otic bullae; 8, external portion of the mastoid, in the later forms at least, modified into an elongated tube surrounding the external auditory meatus, but otherwise not much expanded; 9, in the living forms the stomach is simple, except for a more or less developed pouch near its cardiac orifice, and usually more than two young are produced at each birth.

Family TAYASSUIDAE.

1, Superficial modifications of feet and skull much as in the Suidae, but with a generally more advanced reduction of the lateral digits, and usually, except in the more primitive forms, with metatarsals III and IV coalesced to form a cannon bone; 2, dental series in general as in Suidae, but with the following constant differences: Premolars except in most primitive forms reduced to $\frac{3}{3}$, with tendency to great lengthening of diastema behind the canine; premolars tending to become molariform; molars subequal, not greatly exceeding the posterior premolars in size, more simple than is usual in the Suidae; incisors usually reduced or tending to reduce to two above and below; canines formidable tusks in both males and females, the upper ones being directed downward and slightly outward with no tendency to recurve upward. These are, moreover, usually lanceolate in cross section when unworn, early becoming triangular as the anterior face is worn away by contact with the lower tusk closing in front of it; 3, in the more recent forms, at least, lachrymal small, confined to the anterior margin of the orbit, allowing a wide contact of the jugal with the frontal; lachrymal foramina reduced or absent; 4, zygomatic ridge of the maxillary extending obliquely forward and upward to the side of the face, limiting the backward extension of the rostral sulcus to the region of the infraorbital foramen; 5, basicranial plane bent upward anteriorly, at a very considerable angle to the plane of the palate; 6, glenoid fossae extending downward and forward well below the basicranial plane, and well separated from the external auditory meatus by a broad bony expanse of the mastoid; 7, paroccipital processes, so far as known, relatively short, and directed downward and backward nearly at right angles to the long axis of the bullae; 8, mastoid region expanded into a broad thin plate which overlaps and early fuses with postglenoid squamosal portion of the zygoma, more or less completely obscuring the external form of the elongated tube of the external auditory meatus; 9, in the living forms the stomach is complex, and there are normally no more than two young produced at each birth.

Regarding the validity of the two living genera of peccaries, the following comparative lists of characters seem to distinguish them:

Tayassu Fischer.	*Pecari* Reichenbach.
1. Lower anterior portion of face broader than middle anterior portion, a feature produced by a sharply defined overhanging ledge formed by the lateral swelling out of a ridge of the maxillary, commencing on the inner side of the infraorbital foramen and extending forward to the alveolus of the canines.	1. Lower anterior portion of face narrower than middle anterior portion. No lateral swelling of the maxillary in this region.
2. Upper posterior portion of face relatively broad and moderately curved laterally.	2. Upper portion of face relatively narrow and strongly arched laterally.
3. Outer surface of the jugal below orbit moderately expanded and nearly flat; its inferior external border forming an acute ridge which is continuous but not in a direct line with that of the maxillary which it meets at a distinct angle, the latter continuing forward and upward disappears above and considerably behind the canine.	3. Outer surface of the jugal below orbit relatively shallow, its anterior portion depressed to form a shallow pit, or depression at the anterior inferior border of the orbit; inferior external ridge of jugal continuous in a direct line with that of the maxillary; the latter extending forward and but slightly upward, disappears in a small lateral prominence directly above the canine.
4. Orbito-frontal foramina opening superiorly, relatively close together, directly above the anterior border of the orbit, the deep sulci leading forward away from them in distinctly diverging lines. Anteriorly they slope gently downward on the sides of the face and disappear near the anterior extremity of the maxillary ridge.	4. Orbito-frontal foramina opening superiorly, relatively well apart and farther back than in *Tayassu*, the sulci leading from them first converging forward for about one-half their length, then diverging they pass forward and finally recurve abruptly downward to the border of the maxillary ridge. From the extreme anterior points of these curves a second pair of sulci continue forward along the sides of the face to the upper border of the nasal notch.
5. Space between incisive border and canine not laterally constricted; the extreme anterior border of the maxillary swelling outward at the forward border of the canine forms a shallow depression for the reception of the point of the moderately long lower canines.	5. Space between incisive border and canine latterally constricted; the extreme anterior border of the maxillarly modified to form an angular buttress, past which the posteriorly truncated points of the longer lower canines bite.
6. Cheek-teeth with relatively low, broadly cone-shaped main cusps, and prominent intermediary cusps; the last premolars above and below almost completely molariform and p^3 above submolariform. C a n i n e s relatively short, the upper ones thin and much extended anteroposteriorly with their	6. Cheek-teeth in unworn condition with relatively high and pointed main cusps; intermediary cusps usually incipient, tending to form lophs; last premolars above and below submolariform all premolars tending toward the molariform pattern, but all are more simple than in *Tayassu;* canines

posterior borders directed outward to a degree that were the planes of their long axis extended they would converge to meet within the incisive border; lower canines strongly curved and widely divergent.

7. Diastemata behind canines about equaling length of premolar series.

relatively long and thick, the upper ones with their long axes nearly parallel; lower canines less curved and less divergent than in *Tayassu*.

7. Diastemata behind canines considerably less than length of premolar series.

These definitions seem to clear up to some extent our understanding of the living peccaries, especially in their bearing on the Pleistocene genera, and suggest the following modifications and additions to the definitions proposed by Hay,[1] for *Platygonus* and *Mylohyus*.

Genus PLATYGONUS LeConte.

Peccaries with snout moderately lengthened; functional digits two (III and IV) on each foot, other digits, if present, represented only by simple splints or nodules of bone; outer lower incisors much reduced, frequently wanting; all premolars above and below more simple than the molars, each consisting of a single conspicuous pair of moderately elevated, transversely placed cusps and usually with heavy basal cingulum, the lower premolars having in addition a transverse row of low but well-developed heel cusps, tending strongly toward the condition found in *Pecari*, but less advanced in this respect; molars similar to but more progressive than those of *Pecari*, being composed of two pairs of moderately elevated, transversely placed cusps, which form continuous transverse ridges even in teeth which are but slightly worn; modifications of the upper and anterior portions of the face, and relative positions of the supra-orbital foramina and the suprafacial sulci more nearly like the modifications found in *Pecari* than in *Tayassu;* space between the incisive border and the canines laterally constricted, and the maxillary buttress above the canines formed much as in *Pecari* but more stronly developed than in the living genus.

Genus MYLOHYUS Cope.

Peccaries with long slender snouts; digits reduced to single pairs in the hind feet only, the fore feet retain a second, small but almost functionless pair of lateral digits; outer pairs of incisors, above and below, wanting; last two pairs of premolars, above and below, subequally four cusped, completely molariform, the others submolariform, all with no basal cingulum; molars with four principal little elevated, subsequal cusps, tending to pair transversely about as in

[1] See pp. 217 and 225 respectively of his treatise on The Pleistocene Mammals of Iowa, already cited.

Tayassu;[1] space between the incisive border and the canines not laterally constricted, maxillary buttress for reception of the relatively less heightened lower canine much as in *Tayassu;* characters of upper facial region and posterior portions of the skull unknown.

The foregoing is not intended as a final revision even of the Pleistocene and living peccaries, much less of the entire group and the following is by no means a serious attempt at straightening out all the limitations of Pleistocene species which still seem somewhat confused.[2]

Genus PLATYGONUS LeConte.

Type species.—Platygonus compressus LeConte. (For definition of genus see p. 656.)

Hay has followed Leidy in considering *P. alemani* Dugès as synonomous with *P. vetus* Leidy, and has combined *P. compressus* Leidy with *P. leptorhinus* Williston; yet comparisons of figures and descriptions together with the material at hand, which includes part of the type of *P. alemani*, indicate differences which to me seem sufficient to retain all four species as valid. They may be therefore briefly characterized as follows:

PLATYGONUS COMPRESSUS LeConte.

Synonym. (?)—*Euchoerus macropus* Leidy.

Type.—Fragments of a skull and jaws and a few pieces of other bones. Locality: near Galena, Illinois. Described by Dr. John L. LeConte in 1848.[3]

Diagnosis.—A species of moderate size; total length of cheek tooth series, 74 to 80 mm.; diastema behind canine (upper jaw) about one and one-half times the length of the premolar series; m^2 distinctly longer than wide except when greatly worn by use.

The type specimen is too fragmentary to show other features. If, however, the specimens from near Rochester, New York, described under this species by Leidy,[4] have been correctly referred, the following distinctive characters may be added: Inion relatively low, with sagital crest well arched; temporal fossae short, anteroposterior diameter being about twice that of the orbit; vertical expansion of jugal less than diameter of the orbit.

[1] *Mylohyus* resembles *Tayassu* in much the same way as *Platygonus* resembles *Pecari*, but in *Mylohyus* the premolars and milk teeth are more progressive than those of either of the living genera.

[2] A complete revision of the peccaries in general, including those of the Pleistocene, is a work much needed, but this can not satisfactorily be done except by a critical restudy of actual types and all other available material. Such a critical restudy by the present writer is at present not practical as many of the types and other important specimens are in other Museums, and figures and descriptions may not be relied upon in a work of such extensive proportion as would be thus involved.

[3] Amer. Journ. Sci., vol. 5, 1848, p. 108, figs. 1 and 2.

[4] Leidy, Trans. Wagner Free Inst., 1889, pp. 41–50.

PLATYGONUS VETUS Leidy.

Type.—Portion of a palate containing most of the cheek-teeth and a fragment of a lower jaw containing the last true molar. Present location of type, Academy of Sciences, Philadelphia.

Type locality.—Mifflin County, Pennsylvania. Described by Leidy in 1889.[1]

Diagnosis.—A decidedly larger species than *P. compressus;* total length of cheek-tooth series about 97 mm.; upper molars 1 and 2 nearly as wide as long; apparently no intermediary cusps or loph connecting anterior and posterior lobes of the molars. Other specific characters not known. I provisionally refer to this species a single specimen (Cat. No. 8917, U. S. N. M.), consisting of a portion of the palate of a young individual, lacking the two last molars and carrying the last two milk-molars of the right side. The teeth are about the same size, the molars have the same proportion, and they appear to agree in other respects with those of Leidy's type.

Measurements of specimen No. 8917, referred to P. vetus.

Length of premolar series	40 mm.	
Diameters in millimeters—	Antero-posterior	Transverse.
p^2	12	12
p^3	12	13
p^4	12.5	14+
dp^3	12.5	11.5
dp^4	13	12.5
m^1	16.5	16.3
m^2	20.5	20
Length of premolar series	40	mm.
Length of cheek-tooth series, exclusive of m^3	76	mm.
Width of palate between second molars	22.5	mm.

PLATYGONUS ALEMANI Dugès.

Type.—Portions of a skeleton, including a palate fragment carrying all the cheek-teeth; lower jaws (lacking only a portion of one angle; the incisive border, the crowns of the canines, broken off, and one premolar); the right hind foot (lacking only two phalanges); and portions of a scapula, humerus, ulna, five cervical vertebrae and a rib. This type, lacking the palate and scapula portions, is in the U. S. National Museum (Cat. No. 791).

Type locality.—Near Moroleon, Guanajuato, Mexico; about 200 miles northwest of the City of Mexico. Described by Dr. Alfredo Dugès, in 1887.[2]

Diagnosis.—A somewhat smaller species than *P. vetus;* total length of upper cheek-tooth series (estimated) about 87 mm.[3] It

[1] Leidy, Proc. Acad. Nat. Sci. Phila., 1888, p. 301; Ann. Rept. Penn. Geol. Surv. for 1887, 1889, pp. 12–14, pl. 2, figs. 1 and 2.

[2] La Naturaleza, ser. 2, vol. 1, 1887 to 1890. Note, Dugès' article is dated "Dec., 1886," but it seems not to have been published until 1887.

[3] This estimate is based on the actual length of the lower series which measures 90 mm. In *Platygonus* the lower series exceeds the upper in length from 3 to 5 mm.

further differs from *P. vetus* in the shorter snout, as indicated by the relatively shorter symphysis of the lower jaw; and by the apparently much greater relative width of the palate. This last character is suggested in Dugès's figure, and is borne out by the relatively wide distance between the dental series of the lower jaw of the type specimen.

PLATYGONUS LEPTORHINUS Williston.

Type.—Williston did not designate a type specimen for this species, hence the nearly complete skeleton of an adult female first mentioned and figured by him may be selected. Location of type (?) Kansas University Museum.

Type locality.—Goodland, near Fort Wallace, western Kansas. Described by Williston in 1894.[1]

Diagnosis.—About the size of *P. compressus;* length of cheek-tooth series 75 to 80 mm. (see Williston); proportions and general appearance of teeth about as in that species. It differs from *P. compressus* in having a deeper and shorter jaw angle; in the relatively less antero-posterior expansion of the coronoid process; the more procumbent position of the lower incisors giving a decided angulation to the chin, and in the relatively greater vertical expansion of the zygomatic processes. In *P. leptorhinus* this expansion in the female skull figured is slightly less than the vertical diameter of the orbit. In the male it is nearly one and one-half times the vertical diameter of the orbit.

PLATYGONUS CUMBERLANDENSIS, new species.

Type.—A nearly complete male skull associated with a portion of the lower jaw[2] (Cat. No. 8146, U.S.N.M. Coll.). Paratype: a nearly complete skeleton of an adult female (Cat. No. 8200. U.S.N.M. Coll.).

Type locality.—Cave deposit about 4 miles northwest of Cumberland, Maryland. Collected by Gidley, June, 1914.

Diagnosis.—A large species, nearly equalling *P. vetus* in size. Length of cheek-tooth series, type (male), 94 mm.; paratype (female), 87 mm. Differs also from *P. vetus* in having a greater relative length of the molars in animals of corresponding age, and in the possession in the upper molars of well-developed intermediary cusps and lophs, which connect at their bases the two principal cross lophs, as in *P. compressus* and *P. leptorhinus*. It differs from both these last named species in the much larger size of the skull, in which there is a relatively higher and more backwardly produced inion and a more strongly developed expansion of the zygoma,

[1] Kansas Univ. Quart., vol. 3, 1895, No. 1, July, 1894, pp. 23 to 40 with plates 1 and 8 and seven text figures.

[2] This association is not certain but highly probable, as the jaw portion was found near the skull, and a careful examination of the teeth in the two specimens shows almost exactly the same degree of wear.

the latter being about one and one-third times the vertical diameter of the orbit in the females, and two or more times this diameter in the males.

PLATYGONUS INTERMEDIUS, new species.

Type.—The greater portion of a male skull lacking the condyles and the basicranial region (Cat. No. 8148, U.S.N.M. Coll.). *Paratype*, a nearly complete skull of a female. Cat. No. 8147, U.S.N.M. Coll.

Type locality.—Cumberland Cave.

Diagnosis.—General characteristics much as in *P. cumberlandensis*, but differing from that species as follows: Skull smaller; dentition and especially the canines relatively larger (see table of comparative measurements p. 668); diastema behind canines relatively shorter. A species with teeth relatively large for size of skull.

Measurements in millimeters of skeleton No. 8200.

Total length of vertebral column, atlas to distal end of sacrum	920
Length of cervical series	220
Length of dorsal series	420
Length of lumbar series	130
Length of sacrum	150
Greatest width of atlas	108
Width of condylar facets of atlas	60
Width of axis facets of atlas	53
Length of axis, exclusive of odontoid process	44
Height of spine of axis	30
Height of spine of first dorsal	140
Height of spine of fourth dorsal	120
Height of spine of eighth dorsal	70
Height of spine of second lumbar	30
Height of spine of last lumbar	25
Length of tail (9 vertebrae)	135
Fore limbs and feet:	
Length of scapula	220
Greatest width of blade of scapula	110
Greatest width of articular face	33
Height of spine of scapula	35
Length of humerus	220
Width of proximal articular face	40
Width of distal articular face	34
Anteroposterior diameter of shaft just below deltoid tubercle	39
Greatest length of ulna	240
Greatest length of radius	170
Transverse diameter of sigmoid fossa	35
Transverse diameter of distal face of radius	41
Least width of conjoined bones	33
Transverse diameter of carpus	37
Length of carpus, inside	28
Length of carpus, outside	35
Width of metacarpals III and IV, proximal end	37
Length of metacarpal III, inner side	91
Least transverse width of these two metacarpals	37
Length of the three phalanges of digit III	95

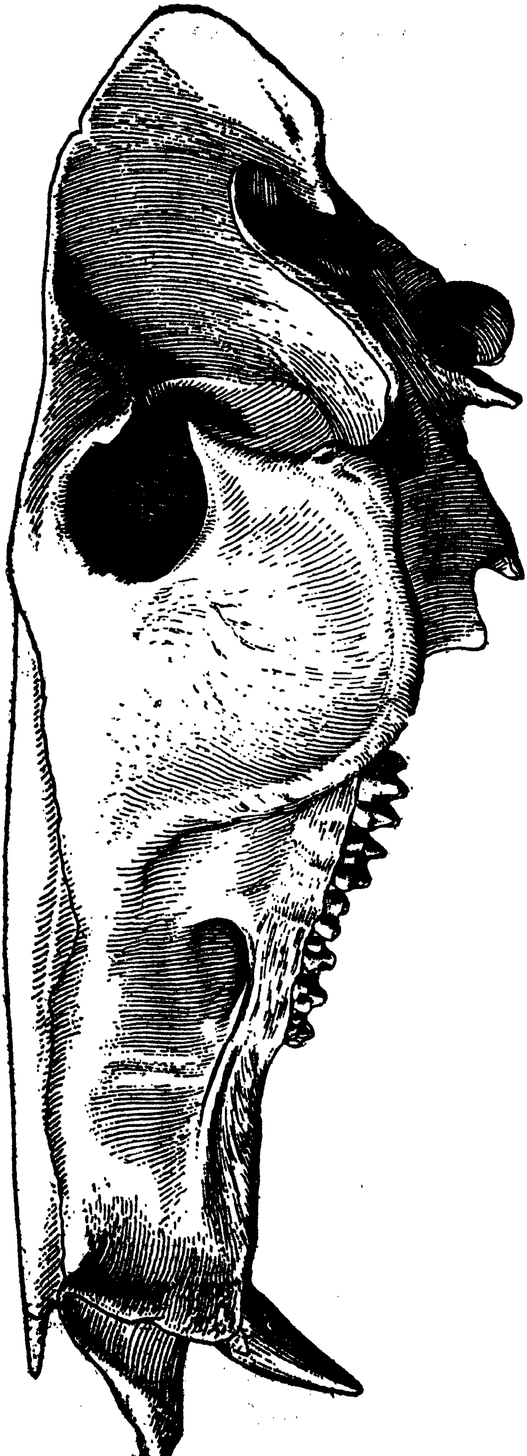


FIG. 1.—PLATYGONUS CUMBERLANDENSIS. SKULL, VIEW OF LEFT SIDE. × ½. TYPE SPECIMEN, CAT. NO. 8146, U.S.N.M.

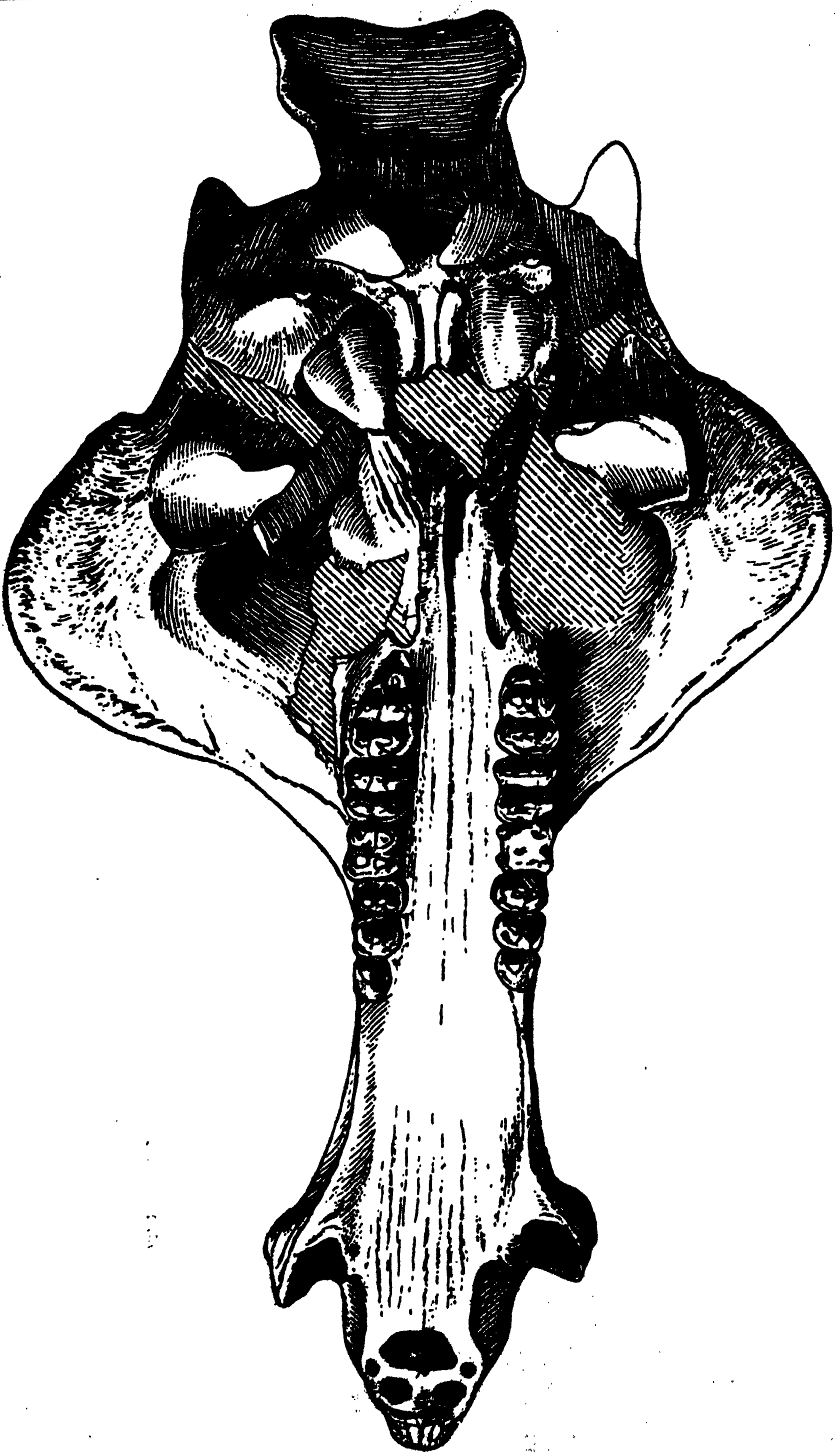


FIG. 2.—PLATYGONUS CUMBERLANDENSIS. SKULL, PALATE VIEW, × ½. TYPE SPECIMEN, CAT. NO. 8146, U.S.N.M.

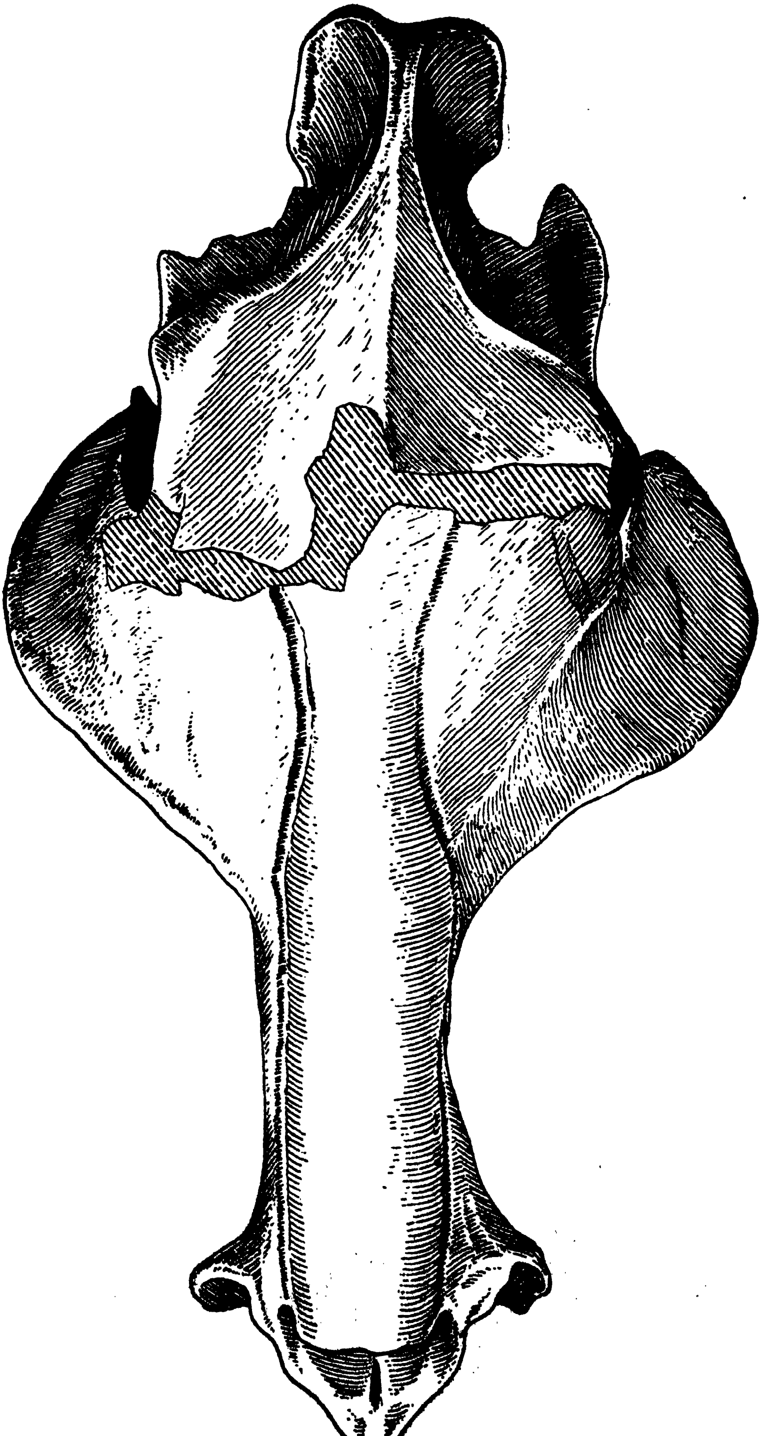


Fig. 8.—Platygonus cumberlandensis. Skull, top view. × ½. Type specimen, Cat. No. 8146, U.S.N.M.

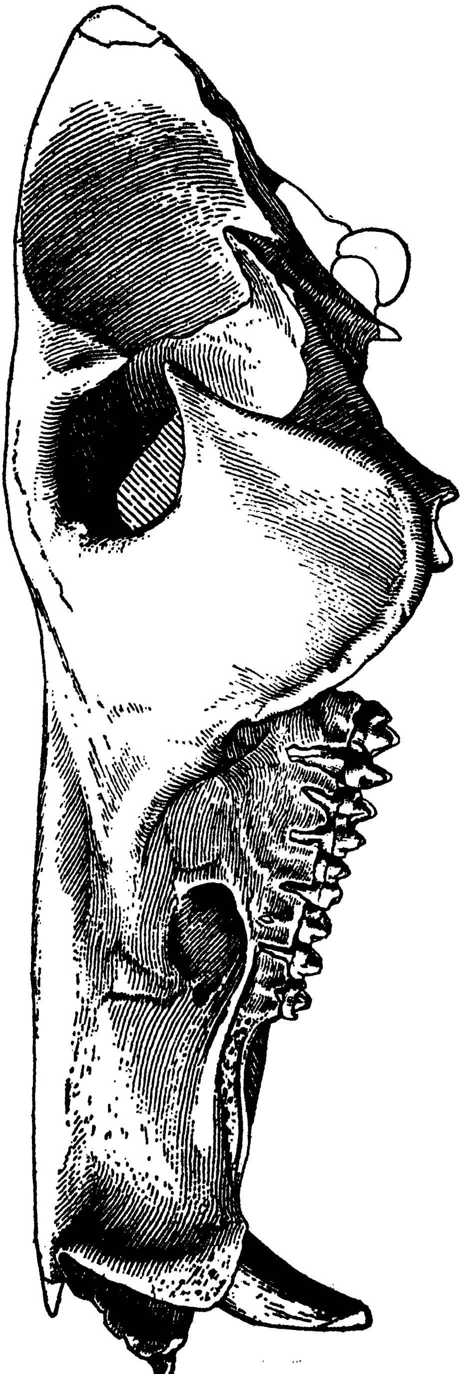


FIG. 4.—PLATYGONUS INTERMEDIUS. MALE SKULL, VIEW OF LEFT SIDE. × ½. TYPE SPECIMEN, CAT. NO. 8148, U.S.N.M.

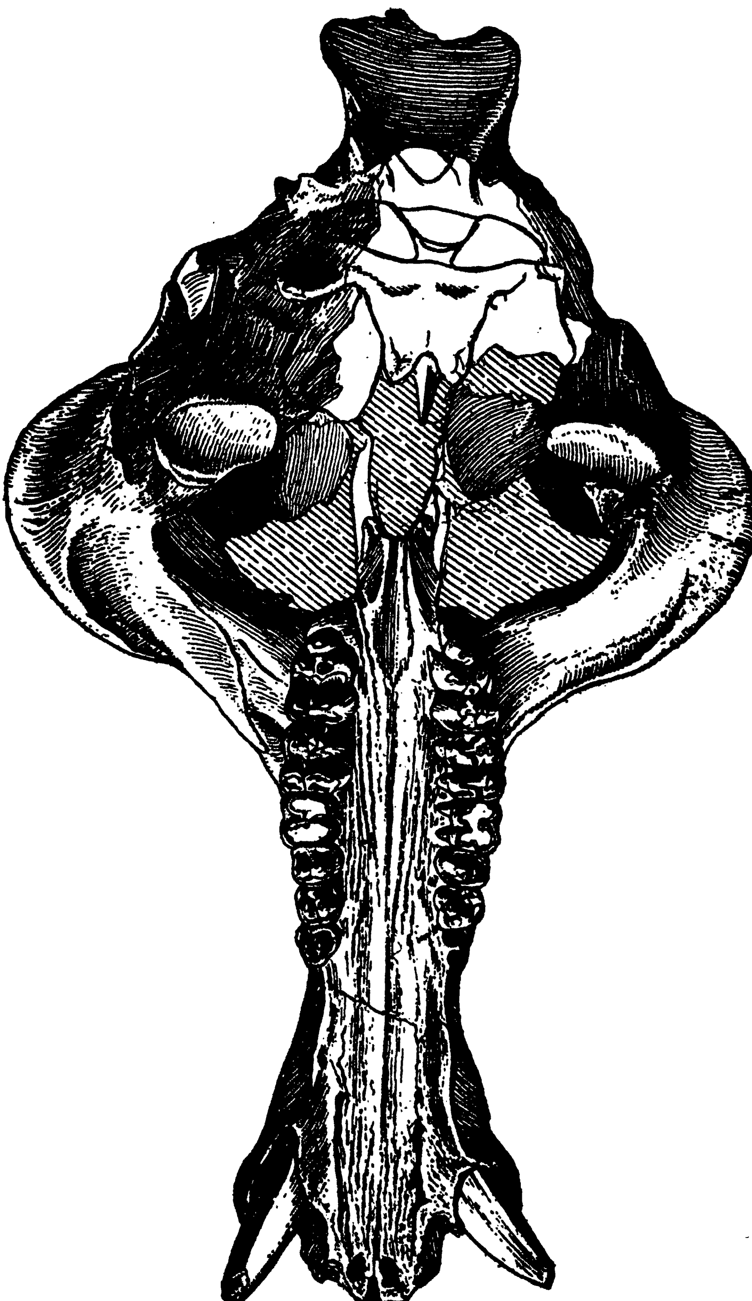


FIG. 5.—PLATYGONUS INTERMEDIUS. MALE SKULL, PALATE VIEW. × ½. TYPE SPECIMEN, CAT. NO. 8148, U.S.N.M.

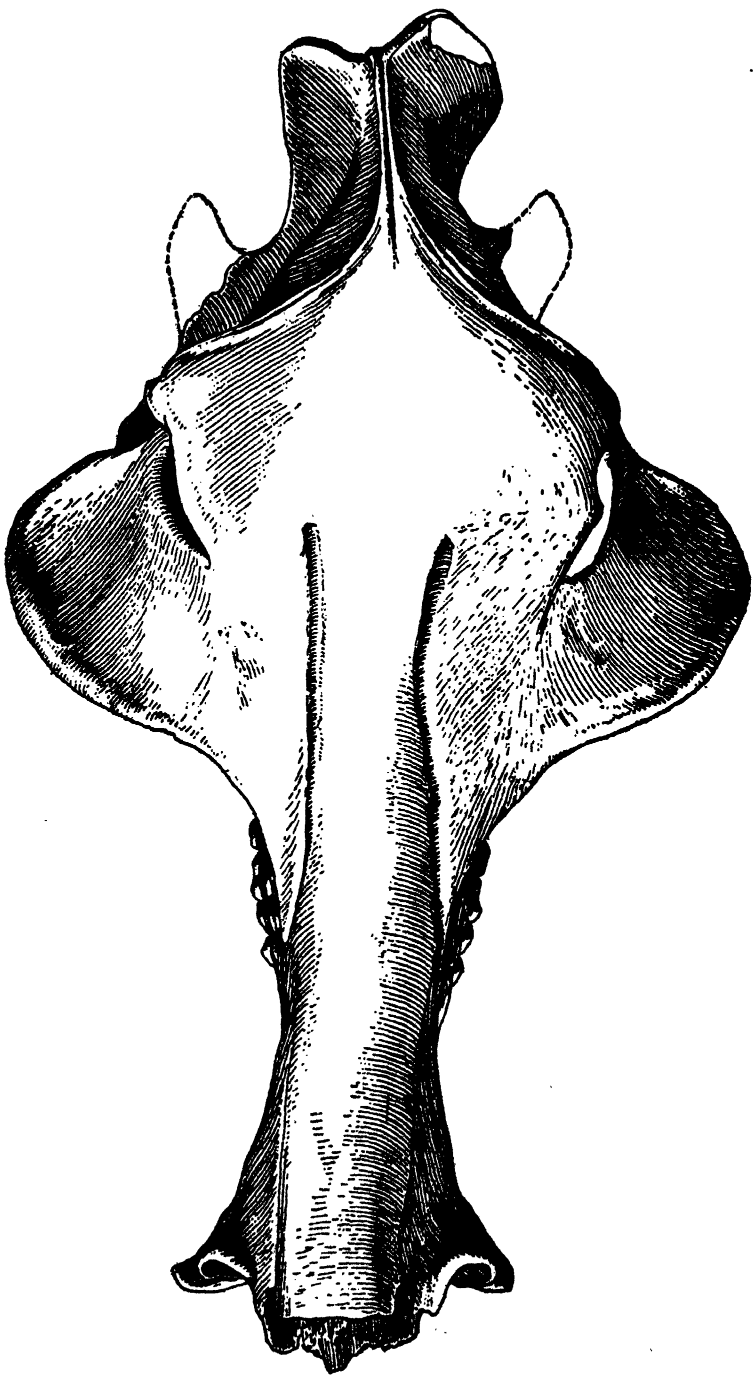


FIG. 6.—PLATYGONUS INTERMEDIUS MEDIUS. TYPE SKULL, VIEW FROM ABOVE. × ½. CAT. NO. 8178, U.S.N.M.

Hind limbs and feet:	
Greatest length of innominate bone	270
Center of acetabulum to anterior border of ilium	140
Center of acetabulum to posterior end of ischium	135
Diameter of acetabulum	35
Length of pubic symphysis	90
Longest diameter of obturator foramen	52
Greatest length of femur	225
Anteroposterior diameter of head of femur	34
Transverse diameter of head of femur	30
Transverse diameter of condyles of femur	53
Transverse diameter of trochlea of femur	25
Length of tibia, inner side	205
Width of proximal end of tibia	54
Width of distal end of tibia	35
Width of astragalus, proximal end	26
Greatest length of astragalus	42
Greatest length of calcaneum	75
Total length of tarsus	62
Width of metatarsals, proximal end	30
Width of metatarsals, distal end	34
Length of tarsals, inner side	97
Least width of fused metatarsals	23
Total length of three phalanges of digit III	86
Ribs:	
Length of first rib	130
Length of fifth rib	260
Length of tenth rib	260
Length of last rib	175

Measurements in millimeters of skull No. 8003, from Renick, West Virginia.

	Anteroposterior.	Transverse.	
Length of cheek-tooth series			90
Length of premolar series			36
Diameters of i^1	10	8	
canine	15.3	10	
p^2 (broken out).			
p^3	12	11	
p^4	11.2	13.8	
m^1	13.5	14.5	
m^2	17.5	16.5	
m^3	23	18	
Length of diastema behind canine			71
Length of diastema behind c and i^1 (i^2 wanting			34
Distance across first pair of molars			60
Width of palate between second molars			26
Width of palate between second premolars			28.5
Width of palate just anterior to cheek-tooth rows			34
Width between canines			46
Basal length of skull, measured from condylar notch			350
Extreme length of skull, including inion			410
Posterior border of orbit to posterior border of inion			112
Diameter of orbit			38

Anterior border of orbit to end of premaxillary	265
Depth of skull at condyles	140
Depth of skull at glenoid fossae	188
Greatest width of zygomatic expansion below the orbit	62
Width of skull across zygomatic expansion	180
Width of face at middle of orbits	120
Width of face at postorbital processes	132
Width of face above infraorbital foramina	47

Measurements in millimeters of Platygonus skulls from Cumberland Cave Deposit.

Total length of dental series, upper	214.0	209.0	198.0	208.0
Length of cheek-tooth series, upper	94.5	86.5	90.5	95.5
Length of premolar series, upper	35.2	34.0	35.0	35.6
Total length of dental series, lower	208.0	201.0	....	200.0
Length of cheek-tooth series, lower	96.0	90.0	....	98.0
Length of premolar series, lower	35.2	34.0	....	36.0

DIAMETERS OF UPPER TEETH.

i¹, lengthwise of the alveolar border	Out.	11.0	Out.	Out.
i², lengthwise of the alveolar border	Out.	8.0	Out.	Out.
Canine, lengthwise of the alveolar border	20.0?	15.0	17.0?	22.5
p², lengthwise of the alveolar border	11.7	11.0	11.7	12.0
p³, lengthwise of the alveolar border	11.7	11.0	11.8	12.0
p⁴, lengthwise of the alveolar border	11.7	11.6	11.0	11.0
m¹, lengthwise of the alveolar border [1]	15.2	12.5	15.0	15.0
m², lengthwise of the alveolar border	19.6	18.0	18.0	19.6
m³, lengthwise of the alveolar border	24.5	20.6	22.0	26.0
i¹, transverse of alveolar border	8.7	....	Out.	Out.
i², transverse of the alveolar border	....	6.3	Out.	Out.
c, transverse of the alveolar border	12.0	10.4	10.5?	13.0
p², transverse of the alveolar border	11.3	10.5	11.0	11.2
p³, transverse of the alveolar border	13.5	13.3	13.0	14.0
p⁴, transverse of the alveolar border	14.3	14.0	13.5	14.5
m¹, transverse of the alveolar border [1]	15.0	16.0	15.0	15.0
m², transverse of the alveolar border	18.0	16.0	17.0	18.2
m³, transverse of the alveolar border	18.2	17.0	18.3	19.4

[1] This tooth in the first two specimens is much worn, the enamel being almost entirely wanting.

DIAMETERS OF LOWER TEETH.

	Type (male) No. 8146.	Paratype (female) No. 8200.	Paratype (female) No. 8153.	Type (male) No. 8147.
i₁, lengthwise of alveolar border	....	6.0	....	7.0
i₂, lengthwise of alveolar border	....	6.4	....	5.0
c, lengthwise of alveolar border	16.5	13.0	....	14.4
p₂, lengthwise of alveolar border	9.5?	10.0	....	10.0
p₃, lengthwise of alveolar border	12.8	11.6	....	12.1
p₄, lengthwise of alveolar border	12.8	11.6	....	12.1
m₁,[1] lengthwise of alveolar border	14.0?	12.6	....	15.4
m₂, lengthwise of alveolar border	20.0	18.0	....	19.0
m₃, lengthwise of alveolar border	25.5	22.8	....	25.7
i₁, transverse of alveolar border	Out.	7.2	....	7.0
i₂, transverse of alveolar border	Out.	6.0	....	6.0
c, transverse of alveolar border	13.4	10.5	....	10.0
p₂, transverse of alveolar border	8.0	7.5	....	7.5
p₃, transverse of alveolar border	10.0	9.0	....	11.8
p₄, transverse of alveolar border	11.7	11.5	....	12.5
m₁, transverse of alveolar border	13.0	11.8	....	11.5
m₂, transverse of alveolar border	15.5	14.0	....	15.0
m₃, transverse of alveolar border	16.0	15.0	....	15.8

LOWER JAW MEASUREMENTS.

	Type (male) No. 8146.	Paratype (female) No. 8200.	Paratype (female) No. 8153.	Type (male) No. 8148.
Length of diastema behind canine (straight line)	76.0?	75.0	....	83.0
Length of diastema between c and i³	4.0	9.0	....	5.5
Length of symphysis in front (in straight line)	100.0	100.0	....	88.5
Depth of symphysis in median line	31.0	30.0	....	35.0?
Depth of symphysis at mental foramen	48.0	45.0	....	....
Depth of lower jaw at m¹	Broken.	52.0	....	49.0
Depth of lower jaw at condyle	Broken.	90.0	....	92.0
Depth of lower jaw at coronoid process	Broken.	115.0	....	107.0
Width between alveoli of lower canines	20.0	22.0	....	20.0
Total length of lower jaw, condyle, to tip of incisors	Broken.	268.0	....	280.0

SKULL MEASUREMENTS.

Length of diastema behind canine	65.0	71.0	56.0	60.0
Length of diastema between c and i³	26.0	26.0	25.0	21.5
Distance across 1st pair of molars	61.0	59.0	57.0	60.5
Width of palate between second molars	22.0	23.5	20.5	21.0
Width of palate between second premolars	29.0	21.0	23.0	28.0
Width of palate just anterior to p²	45.0	36.0	35.0	36.0
Width of palate between canines	50.0	50.0	43.0	45.0
Total basal length measured from condylar notch	360.0	320.0	317.0	325.0?
Extreme length of skull	420.0	382.0	360.0	380.0?
Post-border of orbit to post-border of inion	125.0	92.0	90.0	115.0
Anteroposterior diameter of orbit (nearly circular)	40.0?	38.0	38.0	40.0
Anterior border of orbit to extreme end of premaxillary	270.0	250.0	230.0	235.0?
Depth of skull at condyles	140.0	135.0	132.0	Broken.
Depth of skull at glenoid fossa	130.0?	125.0	120.0?	120.0?
Greatest breadth of zygomatic expansion below orbit	84.0	55.0	46.5	78.0
Greatest width of skull across zygomas	230.0	168.0?	164.0	206.0
Width of face at middle of orbits	135.0	114.0	106.0	120.0
Width of face at postorbital processes	140.0	125.0	116.0	132.0
Width of face above infraorbital foramen	51.0	Crushed.	45.0?	45.0?

In the above table, question marks indicate the exact measurements could not be taken but could be stimated within a reasonable degree of accuracy.

There seems to be exhibited a rather wide degree of variations in certain skull and dental characters in this material from the Cumberland cave, which suggests there are still other species represented. But I have been unable to find any consistent group of well marked differences which at present appear to warrant the recognition of more species than I have here described. In fact, in view of the great degree of variability, which variability my present knowledge of these forms seems not sufficient to properly interpret, it is with some hesitancy that I propose a distinct species even for the specimens just described as *P. intermedius*. However, it appears hardly probable that such a very considerable difference in relative proportions of dentition and skull could exist within a single species. It is possible also that, as I have already intimated, I have allowed too much for "individual variation" in the material I am assigning temporarily to *P. cumberlandensis*. For example, in comparing the skulls of this collection I find a wide variation in zygomatic development (pls. 54, 55). Another species is possibly indicated by a skull (No. 8003, U.S.N.M.) from a cave deposit unearthed in developing a quarry on the west bank of the Green Brier, near Renick, West Virginia (figs. 7–9). This skull, which is evidently that of a female, was discovered, strangely enough, about the same time as the Cum-

FIG. 7.—PLATYGONUS CF. CUMBERLANDENSIS. GIDLEY. FEMALE SKULL, VIEW OF LEFT SIDE. × ½. SPECIMEN FROM RENICK, WEST VIRGINIA. CAT. NO. 8008, U.S.N.M.

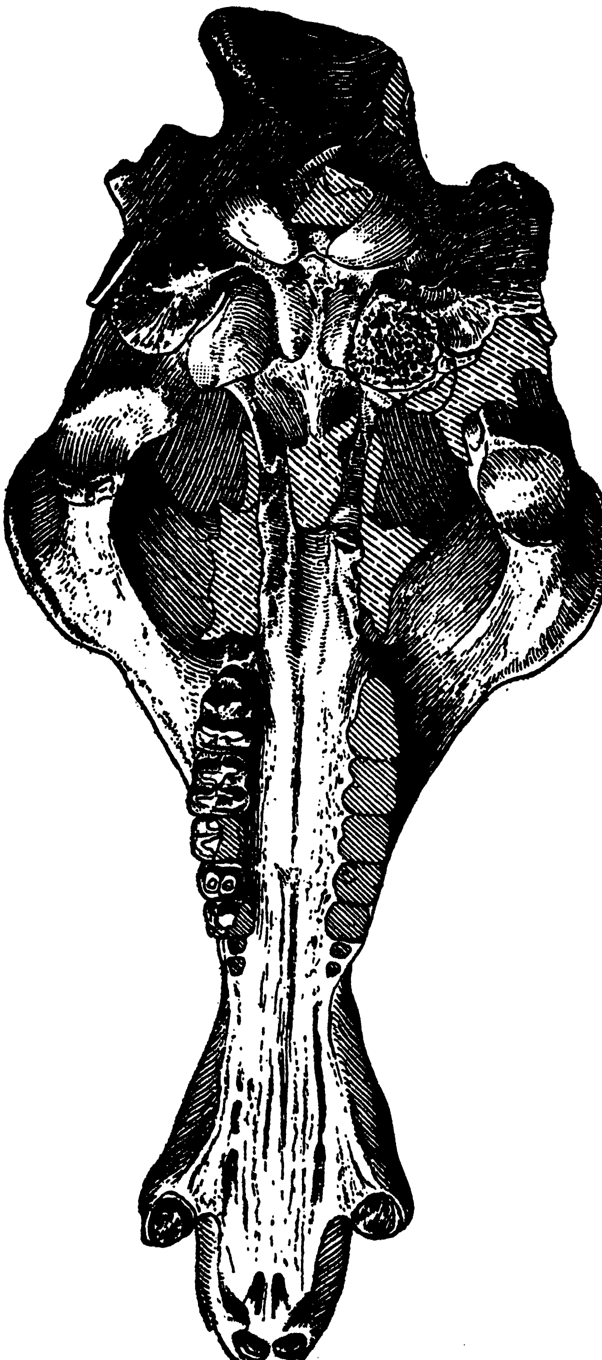


FIG. 8.—PLATYGONUS CF. CUMBERLANDENSIS. GIDLEY. FEMALE SKULL, PALATE VIEW. × ½. SPECIMEN FROM RENICK, WEST VIRGINIA. CAT. NO. 8003, U.S.N.M.

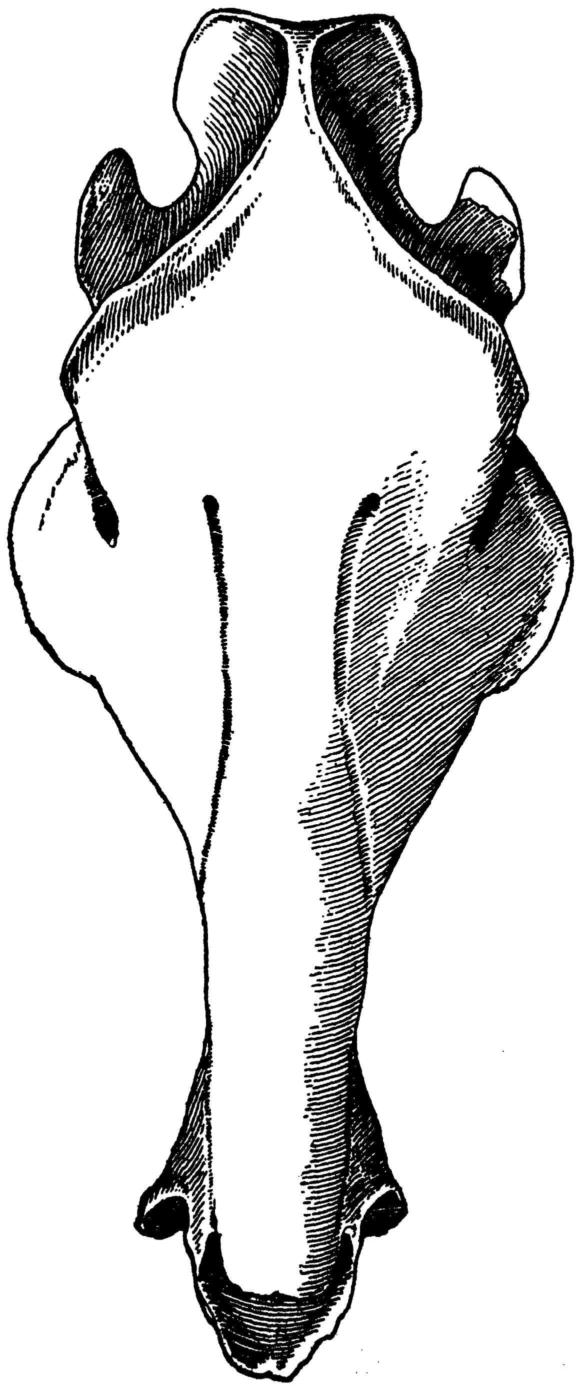


FIG. 9.—PLATYGONUS CF. CUMBERLANDENSIS. GIDLEY. FEMALE SKULL, VIEW FROM ABOVE. × ½. SPECIMEN FROM RENICK, WEST VIRGINIA. CAT. NO. 8008, U.S.N.M.

berland Cave deposit. It is larger than any of the female skulls from the latter locality, but the teeth have about the same dimensions, and much the general appearance of those of specimens I have referred to *P. intermedius.* It differs from both Cumberland Cave species in the reduction of the upper incisors to a single pair. This character, however, should not be relied upon too strongly, since the second pair of incisors is much reduced in all species of this genus. Their occasional absence might mean no more than an individual variation. Still another form seems to be represented by a skull (No. 8151 U.S.N.M. Coll.) in which the characters of the teeth differed more than might be expected between individuals of the same species. In this specimen the canines are relatively long, slender, sharply pointed, and their sides, or plains, are evenly convex, showing none of the longitudinal grooving usually observed. The cheek-teeth have the main cusps relatively higher, more evenly cone-shaped in outline, and the apices of the transverse pairs of cusps, especially in the premolars, more nearly approach each other than is usual in species of *Platygonus.* The specimen, which is that of a young adult female, is too badly crushed to make out some of the more important skull characters. There seems to be little variation in foot structure in species of this genus. (See fig. 10.)

FIG. 10.—PLATYGONUS CUMBERLANDENSIS. LEFT HIND FOOT. × ½. SPECIMEN FROM CUMBERLAND CAVE. CAT. NO. 7690, U.S.N.M.

Genus MYLOHYUS Cope.

Type.—Dicotyles nasutus Leidy.

(For definition of genus see p. 656.)

Three seemingly valid species of the genus have been described, all so far as known being confined to the Pleistocene. In every case the type specimens and subsequently collected material are fragmentary, yet they consist of sufficiently characteristic parts to admit of a reasonably clear definition for the genus as given above. The material collected and described by Brown from the Conard Fissure is especially enlightening and from it we have our first definite knowledge of the foot modifications of this group. The material from the Cumberland Cave here described, likewise fragmentary, not only contributes something in working out clearer definitions for the species hitherto proposed, but adds a new species to the genus.

MYLOHYUS NASUTUS (Leidy).

Dicotyles nasutus LEIDY Proc. Acad. Nat. Sci., Philadelphia, 1868, p. 230.

Type.—Anterior portion of a palate containing the canine and anterior two premolars of the right side, one incisor of the left side, and the alveolii for the other incisors and the left canine.

Locality.—Gibson County, Indiana, discovered in digging a well, at a depth of between 30 and 40 feet.

Diagnosis.—Canines with strongly marked longitudinal ribs, or striations; upper premolars, p^2 and p^3 (other cheek-teeth not known), with anteroposterior diameter (according to Leidy's measurements) as great or greater than the transverse diameter; parastyle, metaconule, and hypostyle appearing as well-defined cuspules; and "a conspicuous outwardly projecting ridge" above the alveolar border of the upper premolars and in advance of the infraorbital canal.

Measurements.—Taken from Leidy's table of measurements, given in lines and here translated into millimeters:[1]

Length of diastema behind canine	62.5
Anteroposterior diameter of p^2	9.2
Transverse diameter p^2	8.2
Anteroposterior diameter p^3	11.4
Transverse diameter p^3	11.4
Anteroposterior diameter of c	11.8
Transverse diameter of c	7.1
Width of palate between the third premolars (estimated from Leidy's figure)	24.0

MYLOHYUS PENNSYLVANICUS (Leidy).

Dicotyles pennsylvanicus LEIDY, Ann. Rept. Geol. Surv., Pennsylvania, for 1887, published in 1889, pp. 8–12, pl. 2, figs. 3–6.

Type.—Portions of the upper and lower jaws each carrying the milk dentition and the first true molar of each side.

Locality.—"Hartman's," or "Crystal Hill" cave, about 3 miles west of Stroudsburg and 5 miles from the Delaware Water Gap.

Diagnosis.—A larger species than *M. nasutus*, with apparently a relatively shorter diastema between the canine and the cheek-tooth series, and (according to Leidy) with the absence of the "conspicuous outwardly projecting ridge" on the alveolar border above the premolars observed in *M. nasutus.*

I refer to the species a fragment of a right lower jaw containing the last two molars (Cat. No. 8162, U.S.N.M. Coll.). These teeth are relatively much narrower than the corresponding ones of *M. exortivus* described on page 676. The measurements are for m_2, anteroposterior diameter 17.2 mm., transverse diameter 13.7 mm.; for m_3, anteroposterior diameter 22.3 mm., transverse diameter 13.5 mm.

[1] Journ. Acad. Sci., Philadelphia, ser. 2, vol. 7, 1869, p. 387.

Measurements of M. pennsylvanicus. Type —. (From Leidy's report)—	*mm.*
Length of symphysis in front	70
Depth of jaw before first molar	30
Thickness of jaw below first molar	30
Width of jaw below first molar	57
Width of symphysis at narrowest point	20

MYLOHYUS TETRAGONUS Cope.

Mylohyus tetragonus COPE, Journ. Acad. Nat. Sci., Philadelphia, ser. 2, vol. 9, 1899, p. 260.

Type.—" An imperfect left mandibular ramus with the corresponding part of the symphyseal region," containing the canine, three milk-molars, and two true molars.

Locality.—Port Kennedy bone deposit, Upper Merion Township, Montgomery County, Pennsylvania.

Diagnosis.—The chief distinguishing feature of this species as described by Cope is the form of the canine, which has the internal posterior angle truncated, giving a tetragonal cross section to this tooth. But this character is so unusual for any suilline I am inclined to consider it pathological. The species, however, seems to differ from *M. pennsylvanicus* (with which it agrees only in size), and likewise from all other described species, in the relatively shorter space or diastema between the canine and the cheek-teeth, indicating a comparatively short-nosed species.

Measurements (after Cope)—	*mm.*
Length of diastema	63
Anteroposterior diameter of c	10
Transverse diameter of c	6
Length of cheek-tooth series from dp_3 to m_2	77
Anteroposterior diameter of p_3 (=pm_2 of Cope)	14
Transverse diameter of p_3	10
Anteroposterior diameter of p_4 (=pm_1 of Cope)	15
Transverse diameter of p_4	13
Anteroposterior diameter of m_1	16
Transverse diameter of m_1	13
Antroposterior diameter of m_2	18
Transverse diameter of m_2	14.5

MYLOHYUS BROWNI, new species.

Mylohyus sp. a, BROWN, Mem. Amer. Mus. Nat. Hist., vol. 9, pt. 4, 1908, p. 201, pl. 24.

Type.—A left lower jaw with symphyseal portion of both sides attached (Cat. No. 11810, Amer. Mus. Nat. Hist. Coll.).

Type locality.—Fifteen miles south of Harrison, near the northern line of Newton County, Arkansas.

Diagnosis.—According to Brown, "agrees in dental characters with *M. tetragonus* with the exception of the canine. This tooth has only three planes, as in *Tayassu*, whereas in *M. tetragonus* it is

described as having four planes in an unworn condition. The measurements, however, differ considerably. The jaw is very long and slender and displays a diastema nearly equal in length to the molar [=molar-premolar] series. The canine is rather small and is separated from the incisors by a diastema of fourteen millimeters. The second pair of incisors is nearly horizontal. Ventrally the symphysis is evenly convex and is contracted to a round heel."

Measurements (after Brown)—	*mm.*
Length of diastema	89
Length of molar series (=cheek-tooth series)	91
Depth of symphysis	18
Width of jaws at narrowest constriction	21

Brown's definition of this form seems sufficiently diagnostic to distinguish it from all other species of the genus. Its comparatively superior length of symphyseal and incisive portions, which indicates an extremely long-nosed form, alone make it readily recognizable. I therefore have proposed for this type the name *Mylohyus browni*.

The second specimen, designated as "*Mylohyus* sp. b." (No. 11814), I regard, as suggested by Brown, probably the male phase of the species just described. The third symphysal portion, designated by Brown as "*Mylohyus* sp. c," however, has all the characteristics of the *Platygonus* group and I believe should be referred to that genus.

MYLOHYUS EXORTIVUS, new species.

Type.—Lower jaw, nearly complete, containing the entire dentition of both sides; and five upper cheek-teeth, p^3 to m^3, of the right side (Cat. No. 8876, U.S.N.M. Coll.).

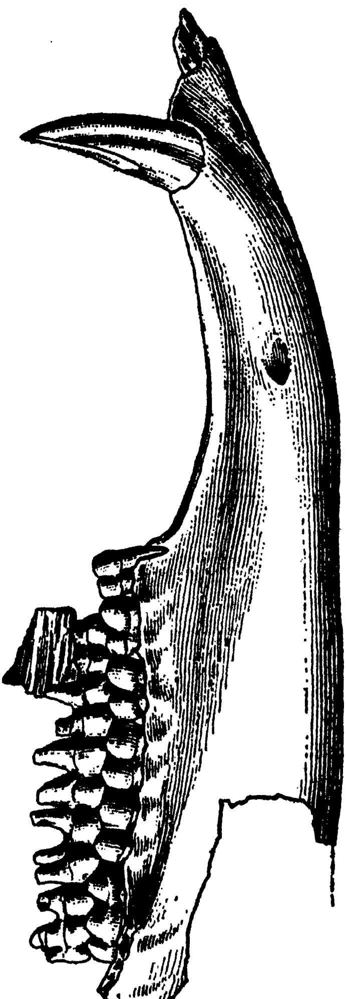
Locality.—Cumberland Cave deposit, 4 miles northwest of Cumberland, Maryland.

Diagnosis.—About the size of or perhaps somewhat smaller than *M. nasutus* (Leidy), and apparently differing from that species in (1) the modifications of the canines, which seem to be relatively wider in cross-section and almost entirely lacking the longitudinal ribbing so characteristic of these teeth in *M. nasutus;* (2) the form of the third upper premolar (the only tooth which can at present be directly compared) which is proportionately broader, while the secondary cuspules are much less prominent; and (3) the relative distance between the cheek-tooth rows of the opposite sides, which is much greater than in the type of Leidy's species.

A second specimen (Cat. No. 8160 U.S.N.M. Coll.), consisting of three milk molars and the first true molar of the right side (see fig. 13), seems to belong to this species, although the first molar, which is entirely unworn, is much narrower than the corresponding tooth in the fully adult type specimen. This difference, however,

may be due to the fact that in the young specimen this tooth had not reached the stage where the roots had begun to form and is therefore so immature as not to have yet acquired its maximum width.

This specimen is especially interesting, since it affords a comparison of the milk dentition with that of the type of *M. pennsyl-*



1.—*Mylohyus exortivus*. Anterior portion of lower jaw and cheek teeth, view of right side. Type specimen, Cat. No. 8876, U.S.N.M.

Fig. 13.—*Mylohyus exortivus*. Upper deciduous molars and first true molar of right side. × ⅘. Specimen from Cumberland Cave. Cat. No. 8160, U.S.N.M.

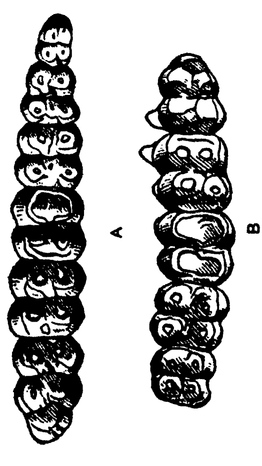


Fig. 12.—*Mylohyus exortivus*. A, lower cheek teeth. B, upper cheek teeth; both of right side. × ⅘. Type specimen, Cat. No. 8876, U.S.N.M.

vanicus. The unworn condition of the deciduous teeth and the incomplete development of the first permanent molar in this species indicate a somewhat younger individual than Leidy's type. It differs from the latter in (1) the smaller size of the corresponding teeth (see table of measurements), (2) in the narrower proportions of the milk-molars, and (3) in the greater complication of secondary cus-

pules, especially in the anterior half of each of these teeth. In this last feature they show a decided advance in complexity of the milk-teeth over those of either of the living genera of peccaries. This is less pronounced in *M. pennsylvanicus* but this species also has more complex milk-molars than either *Tayassu* or *Pecari*.

Measurements of type in millimeters.

Lower teeth and jaws.

	Anteroposterior diameter.	Transverse diameter.
Canine	12.7	9.0
P_2	10.	6.4
P_3	11.	10.2
P_4	12.5	13.
M_1	13.7	13.4
M_2	15.	14.
M_3	19.7	13.3

Length of diastema behind canines	71.
Length of diastema in front of canines	11.2
Vertical depth of symphysis, median line	19.5
Width of symphysis at narrowest point	24.
Depth of jaw below first molar	70.
Thickness of jaw below first molar	20.
Width across both jaws below first molar	70.
Width of jaws at canines	35.
Width between canine alveoli	15.

Upper cheek teeth.

	Anteroposterior diameter.	Transverse diameter.
P^3	10.3	11.8
P^4	12.3	13.8
M^1	14.	14.5
M^2	15.	15.
M^3	16.	13.

Measurements of upper milk teeth (specimen No. 8106).

Dp^2	10.	7.5
Dp^3	12.5	9.
Dp^4	12.	11.5
M^1	14.	11.5

EXPLANATION OF PLATES.

PLATE 54.

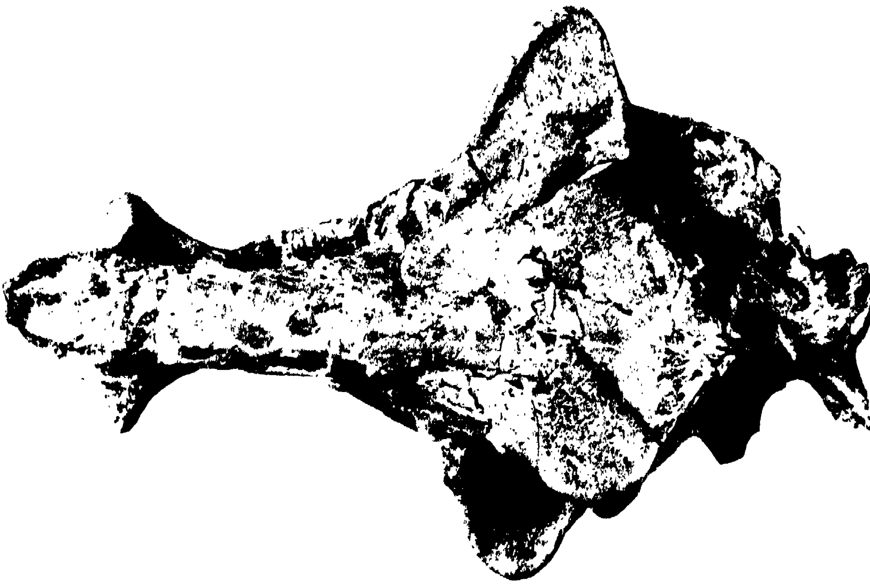
(About one-fourth natural size.)

UPPER—*Platygonus* cf. *cumberlandensis*. Top view of skull No. 7992, U.S.N.M.
LOWER—*Platygonus cumberlandensis*. Top view of skull No. 8000, U.S.N.M.
(Showing supposed extremes of variation.)

PLATE 55.

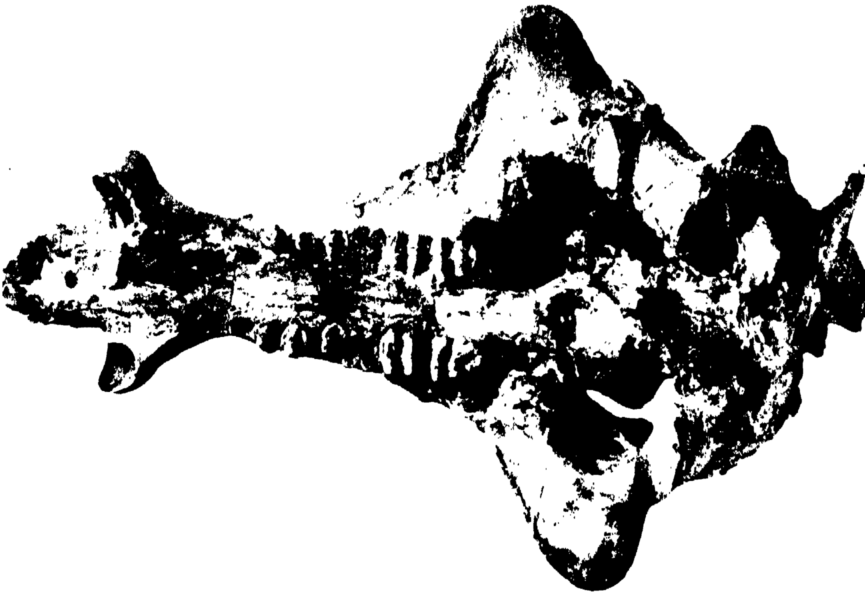
(About one-fourth natural size.)

UPPER—*Platygonus* cf. *cumberlandensis*. Palate view of skull No. 7992, U.S.N.M.
LOWER—*Platygonus cumberlandensis*. Palate view of skull No. 8000, U.S.N.M.
(Showing supposed extremes of variation.)



TOP VIEWS OF SKULL OF PLATYGONUS CUMBERLANDENSIS

FOR EXPLANATION OF PLATE SEE PAGE 678.



PALATE VIEWS OF SKULL OF PLATYGONUS CUMBERLANDENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 678.

INDEX.

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Date of issue.	Date of issue.	Date of issue.
16-6-39		
31-12-47		
1-1-48		
16.6.51		
2.3.2.23		